Apprenticeship training in England – a cost-effective model for firms?

Stefan C. Wolter and Eva Joho

NEW SKILLS AT WORK J.P.Morgan

EDUCATION POLICY INSTITUTE

BertelsmannStiftung

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Content

Preface

In England, the government plans to incentivise spending of billions of pounds over the next few years promoting apprenticeships, with most of the finance raised from the apprenticeship levy on employers.

Promoting more apprenticeships is designed to improve England's skill base – a government policy priority given the relatively low level of skills and educational qualifications amongst a large part of the country's workforce.

But does such a policy make sense in an English context, with a historically limited participation of many employers in work related formal training?

Is additional spending on apprenticeships likely to lead to positive economic returns for employers, workers and for England itself? And how varied are the net economic returns by employer and by sector? What works for one category of employment may not bring positive gains where returns to training are much lower.

To answer these questions the JPMorgan Chase Foundation, the Education Policy Institute and the Bertelsmann Stiftung have come together and partnered with the internationally acknowledged economist Prof. Dr. Stefan C. Wolter to explore the costs and benefits of apprenticeship training for companies in England. This report by Prof. Dr. Stefan C. Wolter and Eva Joho brings a much needed degree of rigour and quantification to a policy area which is too often characterised by assumption, hunch, and international experience which may not apply in a very different country context.

The authors have used evidence from Germany, Switzerland and Austria to simulate the costs and benefits of an apprenticeship policy applied in an English context. They are aware of the limitations of this approach – not least given the different tradition of employer engagement in England – but the analysis in this report is important and could help guide employer and government policies in directions that maximise economic returns and limit low return scenarios.

In particular, the return by occupations is shown to be highly varied based on the return and cost characteristics of each sector. The returns by employer within each sector also vary markedly.

The key conclusions the authors have derived in the report could help steer English policymakers and employers in more evidence based directions, which should help ensure that England's large investment in this area is properly informed by evidence and more likely to yield positive returns. In addition, the present study complements

studies with a similar methodology in Spain (2016) and Italy (to be published 2018), which will enable learnings for successful implementation of apprenticeship models across countries.

We are obliged to Prof. Dr. Stefan C. Wolter and to Eva Joho for authoring the study. Their knowledge of vocational education and their experience in the cost-benefit analysis of apprenticeship training systems have made the present study a reality. We are also thankful to the participants of the workshops that were conducted during the research process.

Hang Ho
Head of Philanthropy for Europe, Middle East, Africa and Latin America,
J.P. Morgan

Rt. Hon. David Laws
Executive Chairman,
Education Policy Institute

Clemens Wieland
Senior Project Manager Learning for Life Program,
Bertelsmann Stiftung

Executive Summary

Countries with a high share of young people choosing apprenticeship training rather than either general education or full-time schooling options have not only demonstrated low youth unemployment rates but also distinctively lower ratios of youth unemployment relative to the overall unemployment rates of the country. Therefore many people consider apprenticeship training as a possible and potentially powerful solution to the problem of an often prolonged and difficult transition for youths from school to the labour market. However, these systems demand high involvement of firms, which is not common in countries that do not have this tradition of apprenticeship training (any more). Because many firms fear the costs of training apprentices, and despite the political support, the dissemination of apprenticeship models has not seen much success in the last ten years. Therefore, it does not come as a surprise that the OECD, in their recommendations for a better skills' policy in England (OECD, 2017b, p.10), ask for more business cases of "successful employee training examples that have led to high return on investment for employers".

If one wants to spread the apprenticeship type of training, it is important to convince firms that apprenticeship models are a potential win-win-win situation, creating benefits not only for students and the public purse but also for the training firms. One way of doing so is by measuring the costs and benefits of firms that train apprentices; however, representative data are currently only available for Germany and Switzerland and, more recently, Austria. In this study, we will – for several reasons – not measure the costs and benefits of existing training schemes in England, but we simulate the costs and benefits for English firms that would train in one out of ten different occupations in very different economic sectors. To be able to simulate these outcomes, we use data from Switzerland, where, over a decade, more than twenty thousand training and non-training firms have provided extensive data on their investments, benefits of training, and reasons for either training or abstaining from doing so. This study therefore analyses the question of whether an average English firm could expect a net benefit when training apprentices in a similar manner to Swiss firms.

The ten occupations for which we simulated the net costs of training are in alphabetical order: bricklayers, car mechanics, care workers, commercial bank employees, cooks, electricians, financial analysts and advisors, IT/software developers, retail cashiers and waiters/waitresses.

The simulation model consists of three components, for which we use data from the most recent Swiss cost and benefit survey, which are complemented with UK wage data.

The three components are:

a) the costs that arise during the training period,

b) the benefits that firms can generate during the training period by letting apprentices substitute unskilled and skilled workers, and

c) the benefits that a firm can potentially generate after the training period has ended, i.e., by filling vacancies for skilled workers with their own apprentices.

In this study, however, we are not able to provide representative figures of the potential size of these saved hiring costs in England, as we have not had not enough observation from participating firms for each occupation that we analyse. However, we have helpful indications from the Swiss studies, which we can compare with the net costs of training after the training period has ended.

Additionally, we also simulate the consequences of our scenarios and models on the private rates of return to education, which is the net benefit that the apprentices could expect over their life-time. This addition to the present study is necessary, because, as will be shown, most firms in England in most of the occupations for which we run our simulations will only break-even (having no net-costs of training) if they pay apprentices' salaries that are either close to or even below current minimum wages.

The results of our net cost simulations for all occupations and scenarios, shows, that the net costs in all models using a low apprentices wage scenario are (with one exception) close to zero or even negative, in other words generating a net benefit. In the high-wage scenario, about half of the occupations and models show net costs equivalent to one monthly salary or more of a skilled worker. In some cases the simulations lead to net benefits that are extremely high, that is for bricklayers, electricians, and IT/software developers. In these cases, apprentices pay could be substantially higher than in our models and still guarantee the training firms to break-even by the end of the training period. For some occupations, however, our simulations show extremely high net costs for the high-wage scenario, as it is the case for car mechanics, commercial bank employees, cooks, retail cashiers, and waiters. In the case of car mechanics and cooks, it is mainly the high share of non productive practicing that reduces the benefits and would therefore legitimate a lower wage than assumed in the high-wage scenario. In the case of commercial bank employees, it is the costs of training hours that would justify a lower pay, and in the cases of care workers, retail cashiers, and waiters, it is the low absolute level of salaries as well as the small differential between unskilled and skilled salaries that creates net costs or pushes down the break-even salaries.

If we compare these net costs with potential savings in hiring costs if the firm is able to keep the apprentices after the training contract has ended, we find that with the exception of waiters, in all occupations, the savings in hiring costs have the potential to cover the net costs even in a more expensive training model, provided the firms are able to retain their apprentices after training. Therefore, incorporating potential benefits to the firms after the training has ended would make the training models viable in most cases and for most occupations.

Using our different wage scenarios for apprentices, we also calculate the rates of return to education for apprentices. We find that in most of the occupations, even low apprentices salaries should guarantee substantial rates of return to education for the individuals to make these training models also attractive to students. The exceptions to these, are a) electricians, where the firms – according to our net cost simulations – should have the scope to raise the salary levels for apprentices such that these could expect sufficiently high rates of return, and b) care workers, retail cashiers, and waiters, where the room of manoeuvre is likely to be limited, in particular for the latter. In other words, the training models for which we have made simulations would not allow firms and apprentices to gain sufficiently, and therefore, the willingness of the firms or potential apprentices to train or receive training in these occupations according to these parameters would be low. Two options would exist, however, to find a way to increase the attractiveness in these occupations. The first option would be that potential apprentices to accept low salaries during training and for firms to invest sufficiently in training allowing the apprentices to expect skilled wages that are above the levels observed on the UK labour market today. Firms would not incur higher net costs and therefore would not need to fear poaching from competitors. Additionally, the potential apprentices could see the lower salaries during training compensated with better salary perspective for the following years of their professional life. The second option would be for firms to accept net costs during training as an investment in future middle management positions, where hiring costs are substantially higher than for lower level positions. In this option, firms would consider their apprentices as the potential future middle managers and the net costs of training apprentices as the necessary investment into this group of employees. In this case, firms would of course have to fear poaching from competitors and therefore would need to make some extra arrangements to prevent high turnover rates of their trained apprentices, including the provision of firm-specific human capital.

Finally, and not surprisingly, the simulated costs and benefits show a considerable heterogeneity, due to differences in the results per occupation in the Swiss data and to variations in the wage differentials between unskilled and skilled workers in the ten occupations in England. Thus, the question whether a training firm would have to expect net costs or could rather enjoy a net benefit when applying a Swiss-like training model depends on many factors that will differ from one occupation to another. Furthermore, the simulations show that, within a given occupation, results may vary considerably between firms of different sizes. In any case, the simulations show that policies targeted to increase the number of apprenticeships would need to take into account these heterogeneities between occupations, firms, and regions.

The five main conclusions that we can draw from our report are the following:

1) The chances for firms of breaking even at the end of the training period of an apprenticeship are highest for three-year programs assuming that the apprentices are younger than 19 years, because minimum wages increase substantially afterwards. Therefore, apprenticeships for young people as an alternative to school-based general education or school-based vocational training may produce the best outcomes from the perspective of firms.

2) From the perspective of apprentices, the programs that would start at an early age, even at a very low pay, would in most cases also generate the highest private rates of return, compared to scenarios, where the apprentices follow a program at a later age.

3) In most occupations and scenarios, big firms have the highest net benefits, whereas micro-companies (less than ten employees) may sometimes even face net costs in scenarios where the average firm can expect net benefits. In sectors where micro companies are the backbone of the industry, particular policy measures to stimulate firms' engagement would need to be considered, whereas bigger firms often do not need special stimuli.

4) In most of the ten occupations, at least one or two models and scenario produce net benefits or firms can expect saved hiring costs that could offset net costs. Yet three occupations in the retail sector and the catering & hospitality sector (cooks, retail cashiers, and waiters) produce simulation outcomes that show difficulties for firms to break even. In the three cases, the skill premium observable today in the UK labour market is too low to guarantee favourable outcomes for firms and apprentices. In these occupations and sectors, one would need to see whether an improved quality of training would increase the workers' productivity and wages sufficiently to make the training investment worthwhile for firms and potential apprentices.

5) Improvements in the quality of training programs that would improve the labour market outcomes of apprentices could be a necessity to secure talented applicants for the programs and thereby also reduce dropout rates. The latter may hamper the willingness of firms to train in some occupations because they would increase the net costs of training.

1 Introduction

Combating youth unemployment

After the outbreak of the financial crises in 2008 persistently high youth unemployment rates in many industrialised countries have brought the apprenticeship training models that are predominantly used in the German-speaking countries (Austria, Germany, and Switzerland) to the attention of policy makers, business leaders, academic scholars, and the public (e.g. OECD, 2010). Countries with a high share of youth choosing apprenticeship training rather than either general education or full-time schooling options have not only achieved lower youth unemployment rates but also distinctively lower ratios of youth unemployment relative to the overall unemployment rates of the country. In addition, skills' shortages or skill mismatches are not as frequent in these countries as in countries with predominantly school-based general education programmes.

Firms have to pay

Although many people consider apprenticeship training as a possible and potentially powerful solution to the problem of an often prolonged and difficult transition for youths from school to the labour market, these systems demand high involvement of firms, which is not common in countries that do not have this tradition of apprenticeship training (any more). Delegating a substantial part of the educational responsibilities to firms makes them not only users but also providers of education, and this comes at a cost for firms. As firms are used to a situation where either the public purse or the students themselves cover educational costs, it is, therefore, not surprising that there is a lack of enthusiasm from firms to bear these costs. Looking to countries where apprenticeships are still common does not automatically calm such fears, because cost-benefit analyses in Germany have shown for decades that the average German training firm[1] must bear the net-costs of training and that only rather rigid labour market regulations allow these firms to recoup these net-investments in the long run. In other countries, like Austria or Norway, public subsidies help keep the firms active in the training market, but the fiscal situation does not allow every country to support training firms, and, in most countries, firms are not particularly eager to pay higher taxes initially to receive some subsidies later. Finally, the political support for apprenticeships is quite often the consequence of empty treasuries and politicians looking for training models that put less strain on the public budgets, which contributes to raising major doubts in economic circles that the support for apprenticeships is just an attempt to shift the costs of training and education from the government to the firms. For these and other reasons, and despite the political support, the dissemination of apprenticeship models has not seen much success in the last ten years. Therefore, it does not come as a surprise that the OECD, in their recommendations for a better skills' policy (OECD, 2017b, p.10), ask for business cases

1 A training firm in the German, Austrian, or Swiss context is a firm whose main business is not training but the production of goods and services. Therefore, when we speak of training or non-training firms in this text, this should not be confounded with training providers, whose main business is training students for firms.

of "successful employee training examples that have led to high return on investment for employers".

Measuring costs and benefits

Therefore, if one wants to spread the apprenticeship type of training, important to convince firms that apprenticeship models are a potential win-win-win situation, creating benefits not only for students and the public purse but also for the training firms. One way of doing so is by measuring the costs and benefits of firms that train apprentices; however, representative data are currently only available for Germany and Switzerland and, more recently, Austria. Measuring the costs and benefits of apprenticeship in case studies, covering just a handful of firms, as has been done in some countries, can lead to deceptive results for non-training firms, as the selective cases are usually not representative. Furthermore, measuring cost and benefits in a country that is in the phase of either introducing or reforming apprenticeships has at least three potential additional shortcomings. First, the training models used by training firms very often differ from firm to firm; second, in a phase of introduction and reform one cannot always be sure that the models in place are performing as expected; and third, the models are very often not stable over time but subject to constant adaptations and changes. In other words, trying to measure something that is showing high diversity across firms, regions, and economic sectors and is changing from day to day has limited informational value for non-training firms in their decision-making process and for policymakers evaluating the framework conditions of their system. Therefore, we have adopted a 'simulation' approach for this report.

Low participation rates

By international comparison, participation rates in employer-sponsored non-formal training and work-related formal training are low in the United Kingdom (UK) and have – despite many government initiatives – declined over time (OECD, 2017b). Therefore, in this study, we both propose and test whether apprenticeship training could be a viable way for firms in England to expand work-based training and, if yes, under what conditions.

Simulating a Swiss training scheme for England

We will not measure the costs and benefits of existing training schemes in England, but we will simulate the costs and benefits for English firms that would train in ten occupations in very different economic sectors. To be able to simulate these outcomes, we use data from Switzerland,[2] where, over a decade, more than twenty thousand doing so and non-training firms have provided extensive data on their investments, benefits of training, and reasons for either training or abstaining from doing so. We use this data as the base for our simulations, combining it with labour market data from the UK. The advantage of simulating, rather than measuring cost and benefits, is that we can choose different models and parameters and, therefore, measure the sensitivity of outcomes for these assumptions. This allows us, not only to make a statement about whether training is beneficial but also to define both the framework and the parameters of a hypothetical model that would work (see Muehlemann and Wolter, 2017).

Simulating rates of return to education for individuals

In summary, this study analyses the question of whether an average English firm could expect a net benefit when training apprentices in a similar manner to Swiss firms but

2 Readers wishing to know more about the Swiss apprenticeship training system may find useful information in this documentation (SERI 2017).

does not evaluate either current English apprenticeships or current policy measures.[3] Additionally, we also (see chapter 6) simulate the consequences of our scenarios and models for the private rates of return to education,[4] which is the net benefit that the apprentices could expect over their life-time. This addition to the present study is necessary, because, as will be shown later, most firms in England in most of the occupations for which we run our simulations will only break-even (having no net-costs of training) if they pay apprentices' salaries that are either close to or even below current minimum wages.

3 This study complements a similar earlier study done in Spain (Wolter and Muehlemann 2014) and another study covering Italy that is in preparation, using the same methodology.

4 We speak of private rates of return to education when we calculate the costs and returns to education from the perspective of the individual in either training or education.

2 The importance of costs and benefits for the decision to train apprentices[5]

Companies' motivations for investment

The willingness of firms to train apprentices can be described as the "conditio sine qua non" (necessary condition) for the existence of an apprenticeship training system. Irrespective of how much a government likes to have an apprenticeship training system, it cannot be established without firms willing to take on the apprentices. Therefore, it is crucial to understand both the motivation of firms to invest in apprenticeship training and the conditions that are necessary to persuade more firms to participate.

Return on investment

Training investments, from the perspective of firms, are similar to all other business investments, which means that firms invest if they to obtain a sufficiently high return on investment (ROI) and that firms renounce investments if they expect a loss. Empirical analyses[6] of successful apprenticeship training models show that the sustainable engagement of firms mainly depends on training regulations, labour market regulations and institutions, and the education policy of the government. An example for the importance of the latter is, e.g., the policy of admission to general education (high school and university) and the financing of it. If the standards for admission into general schools are low and the financing of general education is predominantly public, then firms are confronted with a situation in which most of the talented youth will try the general education route. This would leave only the less-talented students for the apprenticeship market, which would in turn lead to a situation in which the training costs for firms might simply be too high (because less-talented apprentices would need more support and training) and the productivity of the potential apprentices too low. Even in the case that the net costs of training are bearable, firms might decide not to train because the skill level of the potential apprentices would still be lower than the expected skill level of either university or college graduates after a short period of on-the-job training. In other words, policy makers have many ways of not only directly influencing a firm's costs and benefits of training but also influencing the costs of alternative methods of recruiting skilled workers that could compete with the decision to train apprentices.

Risk of losses

A critical point, as with all other investments, is the fact that the costs of training arise early in the investment period, whereas the benefits come either later, sometimes too late, or not at all. The latter may occur because other firms poach the trained workers,

5 Chapters 2–4 are adapted and revised extensions of the respective chapters in the simulations for Spain (Wolter and Muehlemann 2015). We follow as closely as possible the line of arguments and the assumptions used in the Spanish case to allow for future comparative work between different countries for which we have simulated the costs and benefits of apprenticeship.

6 Wolter and Ryan (2011) provide an extensive description of the theoretical foundations for analysing firms' decisions whether be active in apprenticeship training. Muehlemann and Wolter (2014) provide a literature overview of cost-benefit studies and empirical issues related to the question of how the costs and benefits of apprenticeship training influence firms' training behaviour.

because the trained workers leave after training for further education, or for other reasons. In such cases, the net investments at the end of the training period are no longer covered by the benefits that would have been generated if the trained worker had stayed with the training company. The uncertainty about the timing of the benefits, the size of the benefits, or even the risk that no benefits are collected is, therefore, crucial for a firm's decision to be active in the apprenticeship training market. A sustainable training system must, therefore, find ways to reduce the risk that the training might not generate a sufficiently large benefit to cover the firms' investment. Looking at the existing models for which we have cost-benefit data, one can see that, broadly speaking, there are three different ways of doing so.

Securing benefits during training (Switzerland)

One is the Swiss model, where training firms, on average, cover their training expenditures by the time the official training period ends and the apprentice is free to leave the company. In this situation, the threat of poaching is no longer a problem for the firm's decision to train because, even if the apprentice leaves the company the day after finishing the apprenticeship, the firm does not incur a loss. The challenge for firms in Switzerland that train apprentices is, therefore, to find ways for the apprentices to generate sufficiently high benefits for the firm during the training period while at the same time guaranteeing the provision of high-quality training to the apprentices. The benefits mainly depend on training regulations that allow apprentices to spend much of their training time with the firm, working while being with the firm, and, finally, being productive while working.

Securing benefits after training (Germany)

The second case is the German apprenticeship system, where labour market regulations at least partially protect the net investments of firms by reducing the labour market mobility of former apprentices (see e.g. Muehlemann et al., 2010). Rigid employment protection rules (like regulations that make dismissals either costly or almost impossible) not only secure stable jobs for the employed but also reduce the labour market mobility of potentially mobile workers because employment protection reduces the number of job vacancies in the labour market. In such a situation, training firms anticipate that their own apprentices are likely to remain with the training company because the probability of receiving an outside job offer is low, as potential competitors have to retain their own workforce. Thus, a net investment in apprentices protects at least partially from poaching. If labour markets are deregulated, however, firms must switch to a training policy that allows them to either reduce the net costs of training or even break even so as not to risk losing their investment to non-training firms. The reaction of German training firms during the last decade shows that this is exactly the way that firms react (see Jansen et al., 2015). The fact that German firms have, over the course of the last decade, adopted a training strategy that increasingly resembles the strategy applied by Swiss firms provides an additional reason to use Swiss data for the simulations in this study.

Securing benefits with public subsidies (Austria)

The third model is the Austrian one. In Austria, firms have on average net-costs, comparable to German firms, but they differ in two distinctive ways from German firms. Firstly, the reason for the net-costs are not so much a result of apprentices not being used extensively in productive work but rather because of high relative apprentice pay compared to skilled workers. Secondly, public subsidies to firms cover only a part of the net-costs and may be the cause for even higher apprentice pay as the level of subsidies is linked to the level of apprentices' pay. A comparison with comparable Swiss training firms (see Moretti et al., 2017) shows that, if Austrian firms switched to apprentice pay levels comparable to Switzerland, most Austrian companies could break-even at the end of the training period. The reason why Austrian firms are paying high apprentices' salaries and accepting net-costs of training is most probably that the competition for talented apprentices with full-time vocational schools is fierce (in Switzerland full-time vocational schools are much less common) and, because of higher labour market regulation, Austrian firms can recoup more of their training costs after the training period.

Other influential factors

In addition to systemic parameters that influence the average training pattern and strategies in a country as a whole, one can also observe differences in training strategies between firms of different sizes, sectors, occupations, and geographic locations that are related to differences in expected post-training benefits.

Company size

Very small firms are usually unable to offer future employment to (all) of their apprentices and, therefore, they need to break even by the end of the training period; otherwise, they are almost certain to lose their investment (see Muehlemann and Wolter, 2014, p. 16ff). The lower the chances that these firms can break even by the end of training, the lower will be the participation rate of small firms in apprenticeship training. As small firms are the backbone of the economy in many countries, the possibility of achieving net benefits within a short time frame is essential for the emergence of apprenticeship training.

Firm specific skills

Firms operating in sectors or training occupations that offer the possibility of training firm- or occupation-specific skills are more protected against the poaching of their trained apprentices, as apprentices would lose a considerable part of their skills when moving to another sector or firm. In particular, skilled workers in technically advanced firms operating at the forefront of technological progress are in such a position.

Geographic location

The degree to which a firm can protect itself against losing its skilled workers also depends on the geographic location of the firm (Muehlemann and Wolter, 2011; Muehlemann et al., 2013). Although most firms do not use uniquely firm-specific skills, depending on their geographic location they might be just far away enough from the next firm that uses a similar set of skills that most employees would not accept the costs of either commuting or moving to another region for only a small salary increase. However, most firms operate either in economic regions with dense economic activity or in sectorial clusters that come with a high risk that there will be several employers looking for the same set of skills. In this situation, even bigger firms need the possibility to break even with their investments before the training ends to have an incentive to be active in training.

Framework conditions

Finally, even if the framework conditions in a country are such that some firms could earn a net benefit from apprenticeship training, this is usually not the case for all firms (see Wolter et al., 2006) because the specific situation differs considerably between individual firms with respect to their potential to run an apprenticeship training programme profitably. The challenge for countries is that the framework conditions should be good enough for a sufficiently large share of companies to offer training positions. There will always be companies for which "buying", that is, recruiting skilled workers from other firms, is cheaper than training their own personnel internally (see Blatter et al., 2017). However, the higher the probability that a training company can finish a training programme with a net benefit, the higher the chances that the training decision will not be affected by other firms' recruitment strategies.

The following chapter provides an overview of the most important parts of the costs and benefits arising from apprenticeship training that a potential training firm must take into consideration when calculating its ROI.

3 The cost-benefit model and its components

Background of the model

A cost-benefit model to simulate the net costs (or benefits) from the perspective of a firm has been used several times over the last two decades in Germany, Switzerland, and, more recently, Austria to gather representative data on the costs and benefits of apprenticeship training. The model has been refined over time but has remained stable and supported for the most part since its conception in the 1970s. The lessons from the application of the model in different countries during different periods of the business cycle and in hundreds of different occupational profiles covering most of the economic sectors in a modern economy helps us to identify the most relevant parameters of the model to simulate net cost scenarios for a dual apprenticeship system outside of the German-speaking countries, in this case for England.

Model components

The model consists of three components, for which we use data from the most recent Swiss survey and complemented with UK data. The three components are the costs that arise during the training period, the benefits that firms can generate during the training period by letting apprentices substitute unskilled and skilled workers, and the benefits that a firm can potentially generate after the training period has ended, i.e., by filling vacancies for skilled workers with their own apprentices.

In particular, a firm's cost components of apprenticeship training (as described in Muehlemann and Wolter, 2014, p.3) consist of the following categories:

1) Wages of apprentices: regular wage payments, irregular wage payments, and compensation for food, travel costs, or living expenditures.

2) Costs of training personnel: costs for full-time, part-time, and external training personnel for the period in which they are unable to work productively because they are instructing apprentices.

3) Recruitment and administrative costs: wage costs for administrative tasks and recruitment related to apprenticeship training.

4) Costs of infrastructure: machinery/appliances for apprentices at the workplace, rent for premises necessary for apprenticeship training, cost of premises and infrastructure for company training centres.

5) Cost of supplies: costs of supplies used for non-productive activities in the workplace; costs of books, learning software, and videos; and costs of working equipment.

6) Other costs: costs of fees (e.g. exams), costs of recruitment/administration related to apprenticeship training, and costs of external courses, duties, and taxes to third parties.

Benefit components

A firm's benefit components of apprenticeship training consist of the following categories:

1) The value of having apprentices perform skilled tasks is calculated as the time that apprentices spend on such tasks multiplied by the wage that a firm would need to pay skilled workers if no apprentices had been hired. That value, however, is further multiplied by the productivity of an apprentice relative to that of a skilled worker.[7]

2) For unskilled tasks, the value to the firm from having an apprentice perform such work is simply the wage that the firm would have had to pay an unskilled worker.[8]

Ultimately, the difference between the costs and benefits of training results in net benefits (or net costs) for the firm by the end of the training period.

Net benefits or break even

As described in the previous chapter, for many reasons, most firms need to either achieve net benefits or at least break even by the time the training contract ends because all investments not covered by then are at risk of loss if the trainee moves to another company or quits for other reasons.

Saved hiring costs

For those firms that can expect all or at least some of their apprentices to stay with them for at least some time, an additional benefit comes into play. If a firm can fill vacancies for skilled workers with their own apprentices, they can save on hiring costs, which would then justify even a net investment by the time the formal training period has ended (see Muehlemann and Strupler, 2015). Although hiring an apprentice is costly, hiring skilled workers is usually much more expensive. Therefore, in the cost-benefit model, we also calculate the following costs that would arise from recruiting a skilled worker on the external labour market:

1) Search costs (job advertisements, job interviews, etc.).

2) Costs that stem from an initially lower productivity compared to the internally trained workers because the employees hired externally have to learn firm-specific processes and technologies.

7 Thus, if it takes an apprentice twice as long to complete a certain task than it does a skilled worker, the relative productivity is 50 %, which means that the value to the firm of having an apprentice performing skilled work is half of the wage costs associated with employing a skilled worker.

8 Although unskilled work is not the goal of apprenticeship training, it can be an important element – at least at the beginning of the training period – for both the firm and the apprentice. For the apprentice, it does not matter much whether he or she learns behavioural skills, such as punctuality and precision, which are important in the work environment, by doing either skilled or unskilled work. What is more important is the fact that the apprentice has the opportunity as early as possible in the training period to learn these skills both effectively and efficiently. For the firms, the possibility of having apprentices doing unskilled work offers an opportunity to improve the cost-benefit balance. As apprentices usually need some learning time before they can be entrusted with skilled tasks, in the absence of the availability of unskilled tasks, the apprentices would be unproductive for too long, thereby increasing the net costs and risk for a firm, so that it may refrain from offering training positions in the first place. Therefore, using apprentices to perform unskilled tasks is not bad overall, but quality assurance systems are certainly needed to ensure that apprentices are not mainly used as cheap labour.

3) Costs that stem from external training of newly-hired workers.

4) Disruption costs that occur when externally hired employees interrupt the work of the other workers because they need instruction and help.

All of these costs can be saved if the firm successfully fills a vacancy with an apprentice who was trained by the firm.

Problems eliciting numbers for England

In this study, we are not able to provide representative figures of the potential size of these saved hiring costs in England, as we have not had not enough observation from participating firms for each occupation that we analyse. However, we have had some indications, which we mention in the results' section.

Mobility of apprentices after training

The impact of the degree of loyalty to the training firm is, of course, decisive. If, as in Switzerland, two-thirds of the apprentices leave their training company after the end of training, a firm needs to train three apprentices to fill one vacancy (if the apprentices leave their training company voluntarily). In other words, the saved hiring costs for one vacancy, on average, would need to be high enough to compensate for the net costs of training three apprentices in Switzerland, which shows that saved hiring costs are an argument mainly for either (large) firms with an internal labour market or firms with very firm specific human capital and, therefore, also a reasonably high retention rate.

4 The simulation model, data, and assumptions on the parameters

Chapter overview

In this chapter, we provide arguments for the scenarios we have used to simulate the costs and benefits of potential apprenticeship models from the perspective of firms. The scenarios are not modelled on existing English models and are, therefore, not evaluations of the existing apprenticeships in England.[9] However, they could fit into the English context, and we will provide arguments for our scenarios based on the experiences in Switzerland. We will elaborate on certain questions, such as why the duration of an apprenticeship may or should differ from occupation to occupation; what level of payment of a salary for apprentices would guarantee firms breaking even at the end of the training period; and how the quality, the quantity, and the specificity of training that a firm provides is reflected in the hiring costs of skilled labour. We will also provide information on issues that do not directly relate to the cost-benefit simulations but to the actual outcomes, such as the selection of apprentices and the matching of firms and apprentices in the apprenticeship labour market. These issues relate to our assumptions about the parameters in the models and, thus, call for an explanation. We conclude this chapter with information about the sources of the data used in our study.

1. The simulation models

Three different training models

We calculate the costs and benefits of apprenticeship training for three different scenarios (models). Model 1 comes closest to the Swiss apprenticeship model, where apprentices enter training at the end of compulsory schooling as an alternative to general full-time schooling. In Model 2, we assume that young people have completed an upper-secondary education and enter an apprenticeship programme as an alternative to studying at a university. Finally, Model 3 a one-year extension of Model 2. Again, we base Model 3 on the assumption that apprentices enter the programme after having completed general upper-secondary education. The reason for extending Model 2 is that the framework of Model 2 might be too rigid in two respects. First, apprentices may not be able to acquire the required work skills in a programme that lasts for only two years, not because of a lack of time spent in formal training but because of a lack of time spent practicing the learned skills in the workplace. Second, firms that provide (and pay for) a substantial amount of workplace training might not be able to break even financially within a two-year training period because the apprentices do not spend enough time with the firm.

Model assumptions

We base all our calculations regarding off-site instruction times on numbers close to Swiss, German, or Austrian practice (and Spanish training programmes). All the plans are set for

9 Existing apprenticeship models have been researched in small-scale studies in the past years (e.g. Gambin and Hogarth, 2017) and are not representative for all models in place. Furthermore, the dynamic of apprenticeship models is so high that a snapshot at some particular moment would not be representative.

a two-year programme that totals 2,000 hours of training and work experience, of which, depending on the occupation, approximately 1,600 to 1,700 hours are formal instruction in vocational schools, and the remaining hours are work experience in a firm. In Model 1, we assume that the training plan for the off-site education covers not only vocational skills but also some general skills, e.g. maths or foreign languages, that are necessary not only as a foundation to learn other skills but also to be able to progress further in the educational system after an apprenticeship. In Models 2 and 3, we assume that the individuals acquired all of the necessary general skills before entering the apprenticeship programme and that the provider of education covers mostly vocational skills.

The detailed assumptions in the three models for which we calculate the costs and benefits are as follows (see Table 1 for an overview).

Model 1

In **Model 1**, we propose a training duration of three years, which is the minimum duration of many apprenticeship programmes in Switzerland for the training occupations for which we calculate the net costs in England. This model would be most appropriate for school-leavers after compulsory schooling (at the age of 16), who, similar to the German-speaking countries, would follow apprenticeships programme instead of pursuing other full-time schooling options.[10] The curricula used in the German-speaking countries, therefore, also leaves room for learning general skills, such as mathematics and foreign languages. Therefore, to follow a Swiss training programme as closely as possible, we make the following assumptions: Of the approximately 1,600 hours learning vocational skills, 600 hours are delegated to firms and are taught by in-firm trainers, which corresponds to approximately five hours of instruction time per week spent at the firm (which comes close to the Swiss average). The rationale for delegating a considerable part of the vocational programme to firms is as follows: Depending on the technologies used in the trained occupation, the quality of in-firm training should be superior to the same training in a vocational school, as firms are usually at the forefront of technological developments. Moreover, the public authorities experience substantial savings if they do not need to buy expensive machinery and tools for vocational schools. Such a situation is also beneficial for apprentices, as they have the opportunity to use the most up-to-date equipment in firms. An additional benefit of in-firm training is the fact that, on most occasions, the training in firms is 1-to-1 teaching, whereas in schools, the same skills are not taught individually but rather in a class of up to 20 or more students. Given the nature of some skills, practical exercises are often necessary to become proficient; thus, the instruction of one apprentice (or a very small group) by one trainer in a firm seems to be much more appropriate than training a full class.[11]

10 The four main explanations in support of an "early" apprenticeship programme are, first, that school-leavers, when confronted with another three years or more of general schooling and, therefore, with the risk of dropping out of the educational system after compulsory schooling, are more likely to remain in the education system. Switzerland, which has one of the highest completion rates of upper-secondary education in the industrialised world (OECD, 2017a), shows that this strategy can be successful in reducing early educational dropouts. Second, at a young age, and when still living with their parents, an apprentice's pay can be lower than that required for older students, and even a small amount of pay compares favourably relative to the prospect of not earning anything when attending a full-time school programme. Third, training firms like to take in apprentices at a younger age because they can be socialised more easily to the work and to firm requirements and realities. Finally, working together with adults and being tutored by older apprentices in a real-life environment stimulates the learning motivation of young adults and leads to better learning outcomes for those who may have problems with self-motivation in a school environment.

11 Often, 1-to-1 teaching in firms is the standard case, as many training firms only train one apprentice at time. Larger firms usually train more than one apprentice in the same occupation and the same training year and have the opportunity to group apprentices where both possible and necessary, which explains why larger firms can have economies of scale when training apprentices.

General education in school

The 600 hours of vocational education obtained away from school, however, is then replaced by an equivalent amount of time of general education, again taught in vocational schools.[12] Thus, the amount of time spent in school remains the same (approximately 1,600 hours), but it is now spread over three years. Additionally, the apprentice receives the 600 hours of formal vocational instruction in a firm, such that the firm spends approximately 5 hours of instruction time per apprentice for every week that the apprentice is not in school – leading to a total of approximately 2,200 hours of formal instruction time over three years. The rest of the time in the firm is used for both working and practicing and thereby providing not only a financial return for the training firm but also a private return for apprentices by acquiring additional on-the-job skills through informal learning.

Model 2

Conversely, **Model 2** targets approximately 18-year-old individuals who already hold a general upper-secondary qualification and would, therefore, not need to spend more time in general education during an apprenticeship. Similar to Model 1, apprentices receive a total of 1,000 hours of formal (non-general) education in vocational school, and the remaining 600–700 hours of formal instruction takes place in the firms, leading to a total of 1,600 hours of formal vocational instruction. It is important to note here that, while firms training apprentices in Switzerland also believe that an apprentice can either learn while working or is working while learning, there are legal obligations in Switzerland that apprentices receive a minimal amount of formal in-firm teaching. The time spent in the firm is, therefore, not merely learning by doing. In this spirit, in all three models, we calculate, for the delegated hours of formal training from schools to firms, the costs of having an in-firm trainer spending his or her time educating the apprentices theoretically and practically. Firms are expected to provide their part of the training at their own cost, but at the same time, they have the opportunity to train the apprentices in their technologies and business processes and thereby save expensive adaptation costs compared with hiring someone either directly from school or from the external labour market. The apprentices would again, as in Model 1, spend the rest of their time at the firms working and practicing, thereby not only acquiring additional vocational skills through informal learning but also acquiring work-related social skills.

Model 3 as an extension of Model 2

Finally, **Model 3** is identical to Model 2 in the first two years of training, but it contains an additional third year. In Model 2, while apprentices accumulate all the required formal human capital in the first two years, relatively little time remains for productive work in the firm. Thus, for many occupations, firms will not find Model 2 profitable. Moreover, while apprentices acquire substantial theoretical knowledge, firms may want to provide additional general and specific training so that their apprentices can successfully perform the required skilled tasks for the firm. For this and other reasons, apprenticeship programmes in the German-speaking countries last for at least three years and even for four years (3.5 years in Germany) in practically all the technical occupations in Switzerland. Even if we assume that – contrary to Swiss apprentices –

12 The 600 hours of general schooling in firms is not equivalent to what a student would acquire when attending an upper-secondary school in general education and, therefore, is not enough to qualify to enter a general education programme in higher education. However, given the extensive amount of vocational training, the student would certainly qualify for professional education programmes at the level of tertiary education. The same is true in the case of Austria, Germany, and Switzerland. Therefore, in the case of Switzerland, for example, apprentices have the opportunity to spend an extra year on general education either during the apprenticeship or after the apprenticeship, which can then lead to a professional baccalaureate. This certification allows students to continue their studies at a university of applied sciences. If, however, they want to transfer to a classical, academic university, they would have to attend another year of general education.

English apprentices would enter training with an already completed general education at the upper-secondary level, two years of vocational training would be too little time to learn the necessary vocational skills and attain the performance level of a fully trained skilled worker, if the expected skill levels for skilled employees should be comparable to those of Continental European workers. In the additional year that the apprentices spend in training (compared with Model 2), they receive the equivalent amount of formal in-firm training as an apprentice in an average Swiss firm in a comparable training occupation (approximately 200 hours on average). Moreover, an apprentice could work and continue to practise for approximately 1,500–1,600 hours in the last year of training, thereby also accumulating important vocational and professional skills.

TABLE 1 **Assumptions of the baseline simulation models for net training costs in England**

Model 1	Model 2	Model 3
Three years of training	Two years of training	Three years of training
1,600 hours formal education in vocational schools	1,000 hours formal education in vocational school	The first two years as in Model 2
Approx. five hours per week of formal training for each apprentice (approx.. 600 hours in total) + workplace experience	Approx. 600 hours of formal workplace education + workplace experience	In the third year, firms provide formal workplace training similar to a Swiss firm in a comparable training occupation (approx. 200 hours on average)
Total amount of formal school and firm training: approx. 2,200 hours	Total amount of formal school and firm training: approx. 1,600 hours	Total amount of formal school and firm training: approx. 1,800 hours

2. Parameters and further assumptions

Apprentices' wages

Two models of apprentice pay

In countries with an apprenticeship tradition, firms pay apprentices' wages in every month of the training period, irrespective of whether the apprentice is working for the firm or attending vocational school. Conversely, in countries where work experience is viewed as complementary to a predominantly school-based vocational education, apprentices are usually only paid for the duration of the time spent as an intern at the firm. While being at the firm in the latter form of training mainly serves the purpose of acquiring work experience, the wage level during these months is usually also higher than is the average apprentice's salary in the classical apprenticeship model. Thus, one could consider that the two models of paying apprentices are roughly equivalent, meaning that paying less over a longer period equals paying more over a shorter period. However, even if the total value in terms of cash payments to the apprentices is the same in both payment schemes, there may be important differences not directly related to apprentices' pay.

Monthly pay = better matching

In particular, paying an apprentice a salary for the whole duration of a training programme radically changes the nature of the relationship between the firm and the apprentice in many ways. The changed nature of this relationship becomes visible before the apprentice starts working for the firm. When a firm is paying an apprentice a monthly salary in each month of the training period, the apprentice is considered to be a regular employee. Employees are recruited and hired by firms and not by schools. In addition to other benefits, this recruitment has a positive impact on the matching of firms and apprentices, both in terms of quality and quantity. In quantitative terms, if many school leavers would like to obtain training in occupation A, but firms would rather hire apprentices in occupation B, then letting the firms recruit apprentices would lead to more training in occupation B. Conversely, in a school-driven system, schools would have an incentive to offer (too) many training places in occupation A, thus creating a mismatch in the labour market later on. Concerning the match quality, allowing firms to recruit their apprentices at the beginning of the training period provides incentives to firms to pay attention to the individual match and to select suitable candidates from the pool of applicants. In the school-driven model, even if there was no mismatch in quantitative terms, it may be the case that the firms would have selected different apprentices than those that the schools have allowed into their training programmes. As a result, when subsequently confronted with a pool of potential interns, the firms are no longer willing to offer internships, despite having vacant training places (for suitable candidates).

More loyalty and motivation

Moreover, the fact that the apprentice is responsible to the firm from the moment he or she has signed the training (and work) contract is crucial. Even if the apprentice spends most of his or her time in school at the beginning of the training period, the firm has the right to monitor the educational progress of the apprentice and intervene if necessary. For the schools, the employer replaces the parents and becomes the main contact person, and employers ensure that the content and quality of the school instruction matches their expectations. The employee–employer relationship in this type of apprenticeship also has a positive impact on the apprentices' motivation and loyalty to the training company.

Right to training

Finally, but also important, if the firm pays the apprentice a monthly salary that is somewhat lower than that it would pay an intern, the firm also must recognise that the apprentice is not at the firm solely to work but is also entitled to receive formal instruction and training during the entire training period.

Salary: two levels

In Switzerland, there are no binding minimum wages, and apprentices are paid irrespective of whether they are in the firm – if they are in the firm they receive a monthly wage, irrespective of whether they either work or practise. In England, we have to take into account the fact that apprentices and youth are entitled to minimum hourly wages.[13] The main assumptions are the following: In Model 1, we assume that apprentices are under the age of 19 and are always paid the apprentice minimum wage of £3.50 per hour. In Models 2 and 3, we assume that firms pay the apprentices the apprentice minimum wage of £3.50 per hour in the first year of apprenticeship and £7.05 per hour in the second and third (Model 3) years. The minimum wage for the second and third years depends on the age bracket that the apprentice is in. We took the wage as being that for youths aged 21–24, which should correspond to the average age of older apprentices. For all models, we then calculated low- and high-wage scenarios. Common to both scenarios, apprentices do not receive the hourly wage either when in school or when on holiday. This is different for Swiss apprentices with monthly wages, but we assume that a compensation for holidays is already factored into the hourly minimum

13 We have used the national minimum wages in place in 2017: https://www.gov.uk/national-minimum-wage-rates

wage. In the low-wage scenario, firms pay the hourly wage only if the apprentice is used for productive work, which means that, if a firm either sends the apprentices to additional external courses or lets the apprentice practise, it does not have to pay the hourly wage. In the high-wage scenario, we assume that the firm must pay the hourly wage, irrespective of whether the apprentice works or practises, and that absences from the workplace that have been ordered by the firm count as working time.

Consequences of the salary models

These assumptions lead to the following patterns of apprentices' wages: The average hourly wages are different from model to model both because of the level of hourly wages and because we assume different numbers of school days per year in each of the model. In the high-wage scenario, the apprentices are paid the same average wage per model across all occupations, whereas, in the low-wage scenario, the wages differ by occupation in each of the models, as the number of external days mandated by the firms and the amount of time used for practising differ from occupation to occupation.

Private rates of return to education for apprentices

Of course, guaranteeing a functioning apprenticeship market not only requires firms to break-even but also to be attractive to potential apprentices. Therefore, we decided to simulate the impact of these different wage scenarios on the private rates of return to training for the apprentices (see chapter 6).

Break-even salary

In these simulations, the salaries in absolute values are the same across occupations. In reality, this would hardly be the case. In Switzerland, individual firms set the apprentices' pay; therefore, apprentices earn very different wages, depending on the firm and the occupation for which they are trained. Apprentice pay may even depend on individual productivity (see Backes-Gellner and Oswald 2014), and many firms offer apprentices performance-based salaries. Therefore, we complement our analyses with the calculation of break-even salaries. The break-even salary corresponds to the salary that a firm would be able to pay an apprentice if the goal is to have zero net-costs by the end of the training period. Although firms who expect an additional benefit after training could even pay a higher wage than the break-even wage, this wage gives a good indication of the differences between sectors and occupations and demonstrates that a uniform apprentice wage is not efficient in either absolute terms or relative terms (relative to the occupation specific skilled wage).

"Fair pay"

The "right" salary

Regarding relative wages for apprentices (relative to skilled or unskilled workers), it is quite common for legislators and social partners to set arbitrarily ratios that they consider to be a fair wage. The problem with these ratios is that they are usually based on the assumption that apprentices primarily work and that learning either takes place before the apprenticeship or is just learning by doing. In other words, the so-called "fair-pay" assumes that firms do not have extra training expenditures. In doing so, legislators and social partners often overlook the fact that setting ratios in this way actually pushes firms that are interested in training apprentices to reduce their training expenditures to a minimum. Therefore, we propose to calculate "fair pay" as the relative wage that a firm can pay an apprentice conditional to the expenditures that the firm must make to ensure high standards of training. These wage levels correspond to the break-even wages that we have simulated for all scenarios, models, and occupations.

Performance levels (relative productivity)

Using relative productivity

The advantage of our simulation model is the fact that we do not have to assume that the productivity levels are the same in England and in Switzerland – even though the occupations for which we use Swiss data are very similar to English occupations. Using the relative level of productivity of Swiss apprentices to Swiss skilled workers as an indication of the learning progress of English apprentices merely assumes that English firms would be able to train their apprentices in such a way that they would progress in relation to English expectations (i.e. the productivity level of skilled workers in England), just as is in the case in Switzerland. The relative measure also has the advantage that differences in productivity between either firms or regions that are reflected in the differences in salaries for skilled labour are taken into account through the salary level. Firms operating at lower productivity levels can only afford to pay lower salaries; consequently, the benefit in monetary terms of the work of an apprentice is also lower. However, we assume – as observed in the Swiss, German, and Austrian data – that the apprentices reach comparable levels of relative productivity, irrespective of the absolute level of productivity in a given firm or occupation (Dionisious et al., 2009; Moretti et al., 2017). In other words, a firm trains apprentices with the aim of reaching the same productivity level with that apprentice as the firm has with a skilled worker.

Potential biases

Although the differences in absolute productivity between Swiss and English firms in the same economic sector are not important for our calculations, we need to address one potential source of bias. A bias can occur if the competition between the school system and the apprenticeship system is such that the school system has an advantage in attracting the more-talented and higher-motivated students, thereby leaving the apprenticeship training system with the less-talented and less-motivated students. In such a situation, firms may decide not to train at all and to wait for the students to leave college or university and then offer them an internship instead of a formal dual training programme. For firms that still wish to offer a dual programme to the available applicants, such a situation would generate higher net costs, because either the productivity levels of the apprentices would be lower than the comparable Swiss situation or firms would have to spend more money on internal training to reach comparable productivity levels – or both (see, e.g. Muehlemann et al., 2013). In other words, we base our calculations on the assumption that English firms would be able to attract apprentices into their programmes who are similarly able to those attracted by Swiss firms today.

Progress of productivity over time

Thus, for the three-year programmes (Models 1 and 3), we assume that the levels of relative productivity exactly correspond to the levels observed in similar three-year programmes in Switzerland. In Model 2, we calculate a lower bound for the net costs of training and assume that the progress in relative productivity between year 1 and year 2 corresponds to the progress made by a Swiss apprentice between year 1 and year 3 of the training period. One argument that could support this assumption is that, unlike Swiss apprentices, the typical English apprentice in these programmes would have already graduated from upper-secondary school.

Sensitivity checks

Given that the true level of productivity of apprentices in England is not only difficult to forecast but that there would also be a natural and likely considerable heterogeneity between apprentices and training firms, we always complement our simulations with sensitivity checks on different levels of relative productivity of apprentices. Thus, we can at least simulate whether deviations from our parameters that correspond to the Swiss averages would lead to sizeable changes in the net costs of training.

Dropout rates

Dropouts may cause additional costs

In many countries, mainly due to a negative selection of students into work-based training programmes, but sometimes also because of either the poor quality or the bad reputation of programmes, firms face high dropout rates. Dropouts can also be a consequence of the duration of training programmes. If a long duration is not necessary to acquire the skills required to be a professional in the occupation, apprentices have a higher tendency to drop out prematurely.[14] These dropouts may have a negative impact on the firms' willingness to provide future training places, not only because of reputational costs but also because firms cannot recoup their training investments if apprentices dropout too early. To calculate the potential additional costs of providing training places caused by dropouts, we simulate the impact of dropout rates of 25 % and 50 % of apprentices after the first year of the programme. In other words, if training one apprentice successfully in the full programme also means also training an additional apprentice unsuccessfully for one year, the potential costs of this additional apprentice must either be added to the costs for the successful apprentice or, in the case of net-benefits, be deducted from the net-benefits. The reason we are writing about potential costs is the following: dropouts generate additional costs only in programmes where apprentices cause net-costs in the first year of training. If, however, the training scheme allows the firm to cover the training investments very quickly with the productive contribution of the apprentices, dropouts might even either increase the net-benefit or reduce the net-costs of the overall programme. Although, in the latter case, the firm has an incentive to discontinue the training if problems arise, the firm would still face the reputational costs of high dropout rates, which, in turn, would reduce the chances of attracting good apprentices in the first place.

Increases in skilled wages

Higher productivity = higher wages

For some of the occupations in our simulations, although not for all of them, the intensity of training and education in our models exceeds considerably the standards in place today. If this additional training leads to an increase in productivity, which is the purpose of extensive training, we should also see the value-added and, in consequence, the wages of these skilled employees rise above the levels observed in the English labour market today. For this reason, we also simulate models where we assume that the extensive training schemes lead to an increase in skilled salaries by 10 %. All other things equal (*Ceteris paribus*), this additional assumption would lead automatically to lower net-costs of training (and higher private rates of return to education) due to the value of the skilled work which the apprentices are going to substitute increasing and, therefore, their productive contribution to the firm being greater. However, in the end, we also have to assume that, if extensive training creates employees who are more productive and the substitution of these employees generates a higher value-added for the firm, then the costs of training will also increase because more productive and, therefore, better-paid employees must spend their working hours training the apprentices.

14 Nafilyan and Speckesser (2017), in their evaluation of the 2012 apprenticeship reform in England that changed the minimum duration of apprenticeships, estimate that, although the extension of the duration led to higher productivity and wages of the apprentices, it also increased the dropout rates by 3–5 %.

Altogether, it is, therefore, not clear from the outset whether apprenticeships become less costly or even more costly for firms in the period of training. It is a question of whether the productive contribution of apprentices increases by either more or less than the training expenditures do, and this might differ from occupation to occupation.

Other expenditures

Similar to Switzerland

In addition to training expenditures and other personnel costs, as well as the apprentices' salaries, firms that train apprentices also incur other costs, e.g. for tools, spare materials, and machines, that they have to buy either for the purpose of training or that are not used exclusively for production when being used by apprentices for training. While personnel costs and apprentices' wages can be calculated using UK wage data, expenditures for tools or machinery in Switzerland are difficult to transform to the English context because the price level is different between the two countries. Therefore, we assume that the remaining expenditures, other than personnel costs and apprentices' salaries, correspond to the same share of these costs in terms of a skilled worker's salary in Switzerland. Although there is a certain amount of uncertainty attached to this assumption, the impact on our simulations is limited, as personnel costs and apprentices' wages already constitute between 85 % and 90 % of the total gross costs of training in Switzerland.

Costs for off-site education and training

Public provision of school based education

In the German-speaking countries, off-site training and education is usually provided by public schools and fully paid for by the state. In other words, firms do not face direct costs for the education and training provided by schools but must, of course, factor in additional absences of apprentices from the work place, which means less time for productive work for the firm. For this reason, it is not always clear ex ante if the training and education provided by schools for free either decreases or increases the net-costs of training for firms. As a rule of thumb, one can say that, if the training provided by schools for free would have to be provided in any case to attain the expected levels of skills and productivity, the public provision lowers the net-costs of training for firms. However, if some or much of the content learned in school does not translate immediately to higher productivity of the apprentices, the additional absences from the workplace create additional training net-costs for the firm. Because of the complex interplay of factors, one can easily understand why firms in countries with well-developed apprenticeship systems sometimes resist the transfer of training and education to off-site providers, while, in other instances, they lobby for more training and education to be taken over by the schools and paid for from the public purse.

No additional costs for training firms

To make the simulations comparable not only with all the countries for which we are conducting simulations but also with the empirical data collected in Austria, Germany, and Switzerland, we assume that the off-site education is paid for by the government and that the training firms do not have to cover any additional costs for this part of the training programme. In the English context, firms receive subsidies for off-site education (see OECD, 2017b, p. 48). Additionally, the levy scheme, where firms with a pay bill of more than £3 Million[15] must pay an apprenticeship levy but can, in turn,

15 https://www.gov.uk/government/publications/apprenticeship-levy-how-it-will-work/apprenticeship-levy-how-it-will-work#pay-apprenticeship-levy; consulted 18.1.2018.

receive levy funds to pay for training providers is a further argument, to assume that the off-site education of approximately 20 % of the training time does not create extra costs for the training firms, as firms need to pay the levy regardless of whether they train apprentices.

3. Data

Data sources

We use three major sources for the data in our simulations.

Cost-benefit survey data (Switzerland)

The first source is the most recent cost-benefit survey data from Switzerland (see Strupler & Wolter, 2012), which collected data on the costs and benefits of apprenticeship training from a representative set of approximately 2,500 Swiss training firms. This study was the third to be conducted within one decade in Switzerland (see Schweri et al., 2003 and Muehlemann et al., 2007 for previous results), and the results remained remarkably stable over the business cycle.

Investments in time and productive contributions

This source is used to obtain all of the necessary data regarding the following investments in training and the productive contributions of apprentices: The weekly number of training hours that a firm invests per apprentice; the number of hours spent by other personnel (such as HR services) involved in hiring and training apprentices; the share of unproductive time spent by apprentices in the firm (mainly used for practice); the number of hours apprentices substitute unskilled workers while in the firm; the number of hours apprentices substitute skilled workers while in the firm; the productivity levels in a given year of training relative to skilled workers in the same occupation; and, finally, the amount of money invested in spare material, tools and machinery and other expenditures related to apprenticeship training. All of the relevant data are averages for Swiss firms training apprentices either in the same occupation or in the occupation that is most similar to the English occupation.

English wage data

The second data source is wage data for the economic sectors and occupations for which we run our simulations in England.[16] To calculate the productive contribution of the apprentices, we used the average wages of skilled workers in the same occupation in addition to the wages earned by unskilled workers in the same economic sector. In some sectors, the reported data show that currently, an average unskilled worker earns almost as much or, sometimes, as much as an average skilled worker in the same economic sector. The most likely explanation for this result is a difference in years of tenure between an average older unskilled worker and a younger skilled worker.[17] In our simulations, when calculating the productive contribution of an apprentice performing unskilled labour, we assume that the value of this work is equal to what a firm would have to pay an average unskilled worker who it would hire today from the labour market. The situation would, however, be different if a firm could secure only very young people for unskilled jobs, as – given the wage statistics – they have to pay them less. Therefore, we also simulated all models assuming that all firms would be able to hire only young unskilled people for the specific functions. The impact of this assumption on the results

16 The EPI provided wage data from the Quarterly Labour Force Survey (July–September 2016) covering the whole of the UK and with a sample size of 88,464 people.

17 Furthermore, the data sometimes showed that younger workers earn more than do older workers, which may be due either to changes in the skill profiles over time or to selection effects.

is not particularly strong, but it increases the net-costs of training because it reduces the value of the work that the apprentice is contributing to the firm when substituting an unskilled person. Whereas higher wages for unskilled work have a negative impact on the private rates of return to education (see chapter 6), they do, in general, decrease the net costs of training if a firm has unskilled work that can be done by apprentices. However, although high wage levels for unskilled people is an incentive for firms to substitute these workers with apprentices, it can be detrimental for the system as such, as the ultimate goal of training is not to substitute unskilled workers but to be trained to substitute skilled workers.

Other personnel categories

As for training and personnel expenditures, we used the salary data for skilled workers in the training occupation, in addition to other categories of workers (such as HR personnel) involved in either the training or the management of apprentices.

Hiring costs

We tried to collect data on hiring costs, as there are no English data available on the hiring costs of new workers. As the labour market situation differs considerably between Switzerland and England, we were also not able to use existing Swiss data for this purpose. The data were collected at the end of each sectorial workshop.[18] Unfortunately, the number of questionnaires was not high enough to make any firm statements about hiring costs, and it was by no means representative of the whole English economy. Therefore, we have to refrain from reporting them in detail.

Big firms have higher takeover rates

The degree to which a firm can save on hiring costs per trained apprentice depends on many factors, such as the labour market situation for graduated apprentices, the loyalty of apprentices to the training firm, and the within-firm opportunities for apprentices. The experiences in Germany and Switzerland show that larger firms with internal labour markets have higher takeover rates than small firms and also firms with high amounts of firm-specific knowledge, and can, therefore expect higher savings in hiring costs.

18 The six sectorial workshops lasted half a day each. The participants were asked to validate the assumptions used for these simulations and had the possibility of checking the impact of alternative assumptions and parameters on the net-costs of training. The research team was present in the workshop with the computer-based tool to calculate the net-costs to make additional simulations on the spot.

5 Simulating net training costs – a detailed analysis

Chapter overview

In this chapter, we illustrate the simulations of the costs and benefits of various training models in detail for the occupation of a car mechanic and provide additional descriptive statistics. We present all detailed results of the other nine training occupations (but without further explanations) in the appendix.

1) We estimate the net training costs for all three baseline models, as outlined in the previous chapter (Chapter 4) for this occupation.

2) We provide a sensitivity analysis regarding the productivity of apprentices relative to skilled workers at the beginning of an apprenticeship. Thus, we show how the net training costs change when we allow for different assumptions of the productivity parameter.

3) We present a break-even analysis for trainee pay, showing at what level of monthly apprentices pay a firm could offer apprenticeship training at zero net costs.

4) We discuss how net costs vary by firm size, as large firms typically offer higher wages, particularly for skilled workers.

5) We show how different dropout rates affect the net costs of training.

6) We show the impact of a 10 % wage increase of skilled labour on the net costs of training.

Net training costs for apprentices

Pay level matters most

When looking at the results for the three baseline models (see Table 2) with two different apprentice pay scenarios, it becomes immediately clear that, from the firm's perspective, net training costs vary greatly not only due to the different apprentices' wages but also between the different scenarios. While net training costs are higher than £ 12,000 in the high-wage scenario in Model 3, a firm can expect to generate a net benefit of around £ 500 from training an apprentice according to the same Model 3 in the low-wage scenario. The differences of the outcomes between the wage scenarios are easily understandable, but the differences between the models when switching between the different wage scenarios need explanations. Model 3 is as good as the other case in the low-wage scenario, but the net costs are double for Models 1 or 2 in the high-wage scenario. The reasons for this increase in Model 3 in the high-wage scenario compared to Model 1 lie in the fact that in the third year, the apprentice has no absences anymore due to off-site education, and these absences do not need to be paid according to our assumptions. At the wage level of some £ 7.05 an hour, however, the productive contribution is not high enough to cover the costs of the additional 200 hours of on-site training. In this case, the apprentice pay exceeds the 'fair-wage', and therefore, the extension of the apprenticeship duration does not generate a possibility for the firm to make an extra benefit and lower the net costs (compared to Model 2) but increases the net costs. Although Model 1 has also a duration of 3 years, it does not increase the net costs significantly compared to Model 2, because apprentices earn half the pay in year three compared to Model 3.

TABLE 2 **Net training costs – Car mechanic England**

Wage level	Model 1	Model 2	Model 3
Low wage scenario	-653	-330	-524
High wage scenario	6,790	6,018	12,067

Source: own calculations

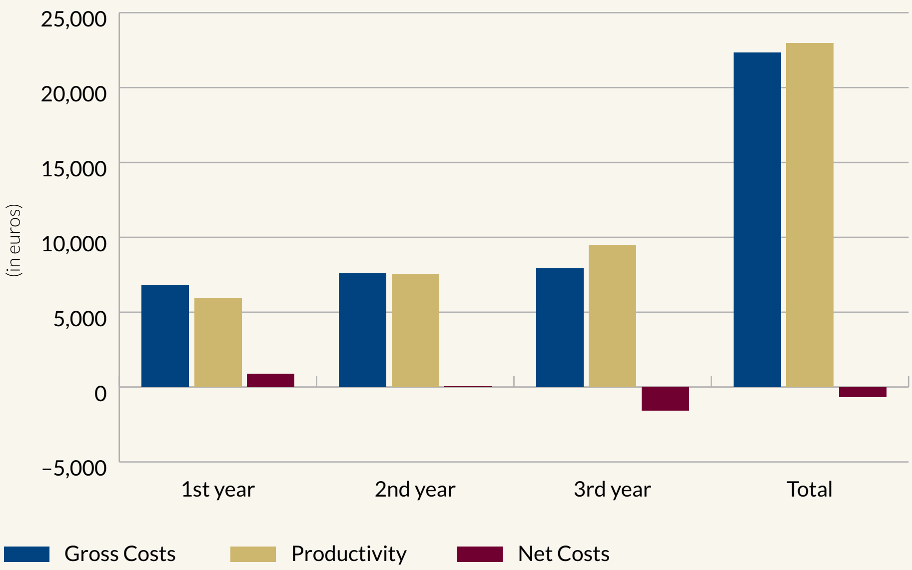
Substantial potential savings in hiring costs

Although we were not able to get representative data on the costs of hiring a new car mechanic, we obtained evidence from the workshop that firms training car mechanics face substantial hiring costs if they have to hire a skilled worker on the labour market. Besides the usual recruitment costs, and in particular due to car brand specific technologies, the hiring firm would need to partially retrain the hired mechanic. In Switzerland, an average firm across all occupations faces hiring costs between 2 and 4 monthly wages of a skilled worker but needs to train on average three apprentices to retain one. If, as a rule of thumb, we assumed that average English firms are in a similar situation, and the hiring costs equal up to four monthly salaries, but retention rates are a little bit higher than in Switzerland (50 %), then the hiring costs would not be sufficient to offset the net costs of any of the training Models in the high-wage scenario completely. However, this additional benefit would help firms to almost break even in Models 1 and 2 in the high-wage scenario. If, due to brand-specific training, firms were able to retain all their apprentices, saved hiring costs would on average even come close to covering the net costs observed in Model 3. However, it also becomes evident that if firms faced high turnover rate of apprentices after training, these additional benefits would disappear immediately.

Net costs evolution

The net training costs also evolve over time (seeFigure 1): In the first year of training, costs usually surpass benefits; in the second year, the firm breaks even; and in the third year, a net benefit arises. This is a rather usual pattern and mainly the consequence of rising productivity of the apprentice over time. Although the apprentice earns a fixed £ 3.50 per hour, the costs of training also rise over time. This is a consequence of our pay assumptions in the low-wage scenario, in which we assume that firms do not need to pay apprentices when they are practicing or sent to external courses. As this happens more frequently in the first year of training, this lowers the wage costs in the first year substantially, while in the third year, the apprentice spends more working on site, and therefore, the wage bill rises as well. However, because the benefits rise more quickly than the costs, the third year of the apprenticeship helps the firms to break even by the end of the training period. These are the results for Model 1 in the low-wage scenario. In the high-wage scenarios, the firms face net costs in each year of the program resulting in substantial net costs at the end of the training period.

FIGURE 1 **Gross costs, productivity, and net training costs by year of training – Car mechanic England**



Source: own calculations, based on model 1 (low wage scenario)

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More time at the workplace increases costs

In our model, the trainee wage level is constant for each year of training in Model 1 but increases over time due to fewer absences from the workplace, and the pay level even doubles for year two and three in Models 2 and 3. This is quite similar to actual patterns of wages observable in other countries, where apprentice pay is typically lower at the beginning of an apprenticeship and increases over time (Strupler and Wolter 2012). This also leads to a situation in which the apprentices are often absent from the firm when wages are lower and their productivity in skilled tasks is still very low (e.g., in digressive vocational school system models, where apprentices spend more time in school at the beginning of an apprenticeship). Therefore, when apprentices spend more time at the workplace towards the end of the training period, not only are their wages higher but also is their productive contribution, which in most cases leads to net benefits in the second half of the apprenticeship period.

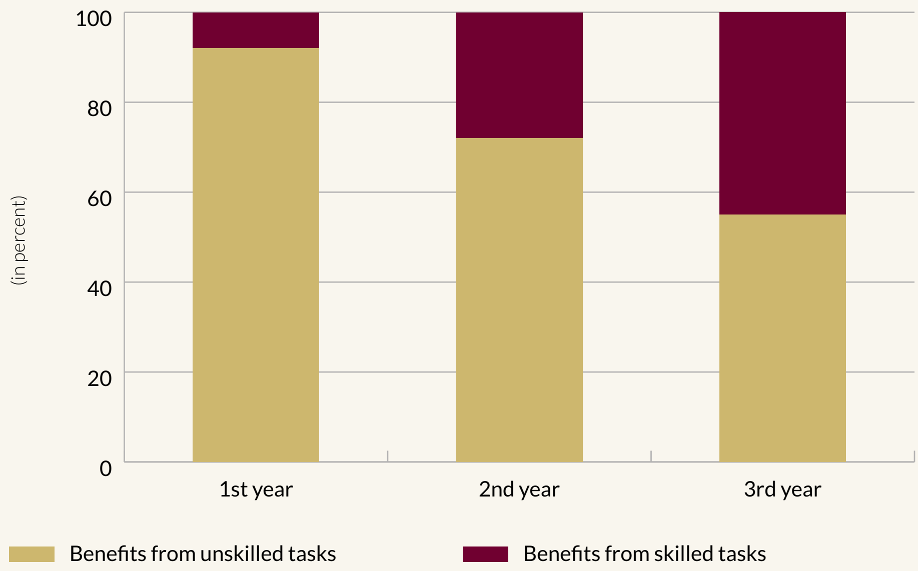
Costs of instruction time

Instruction time at the workplace, another important cost component, does not vary in our model across the different years of training. The reason for this assumption lies in the observation that the instruction time in Swiss firms varies very little in the different years of an apprenticeship program.

Sources of benefits

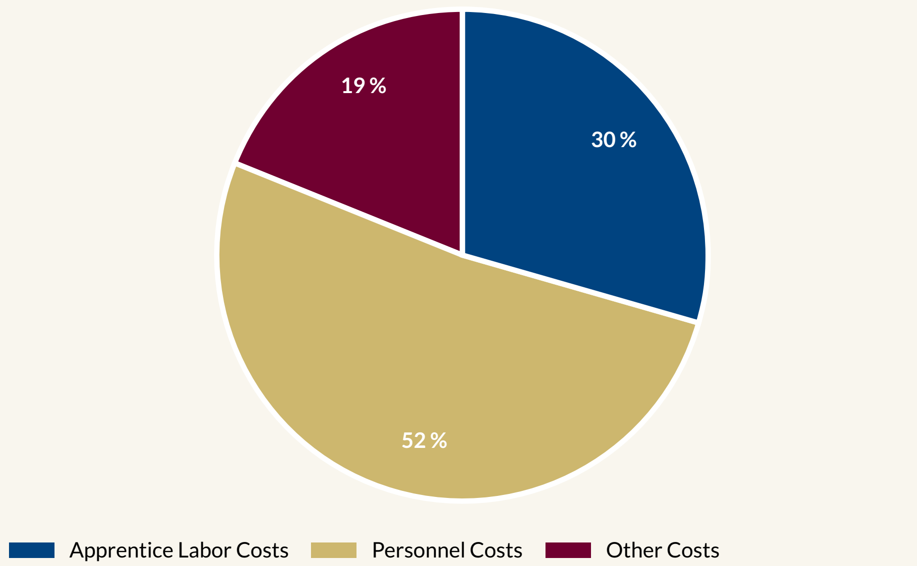
As apprentices become more experienced in difficult tasks, usually performed by skilled workers, firms also allocate a higher fraction of such tasks to apprentices relative to unskilled tasks. Figure 2 shows the composition of training benefits by training year stemming from apprentices substituting skilled and unskilled workers. While almost all the training benefits are due to low-skilled tasks in the first year of training, only half of these benefits result from high-skilled tasks in the third year of training. The shares of the training benefits that one can attribute to low- or high-skilled tasks, however, do not correspond to the shares of time devoted to these different tasks. When high-skilled tasks are very difficult to perform, the productivity of the apprentices is low compared to that of the experienced staff. If the wage levels for unskilled workers relative to skilled workers are rather high, then the share of benefits accruing from low-skilled tasks may still surpass the share coming from high-skilled tasks even if the firm uses apprentices predominantly for skilled tasks.

FIGURE 2 **Composition of training benefits by year of training – Car mechanic England**



Source: own calculations, based on model 1 (low wage scenario).

FIGURE 3 **Composition of gross training costs – Car mechanic England**



Source: own calculations, based on Model 1 (€300 monthly apprentice pay).

Cost components

Regarding the components of the gross training costs, Figure 3 shows that most training costs are in fact wage costs for apprentices and training instructors. In the case of Model 1, apprentice wage costs account for 30 % of total training costs. Conversely, the costs for instruction at the workplace amount to 52 % of total training costs, leaving less than 20 % for other expenditures, such as infrastructure or materials used for training purposes. In Model 2 (again in the low cost scenario), the shares of apprentice pay and training costs would be almost equal (and come close to the Swiss case), and in Model 3, the share of apprentice pay (48 %) would exceed the share of training costs (39 %), and the shares for other costs would drop to 14 %.

Sensitivity analysis of apprentice productivity

Sensitivity checks

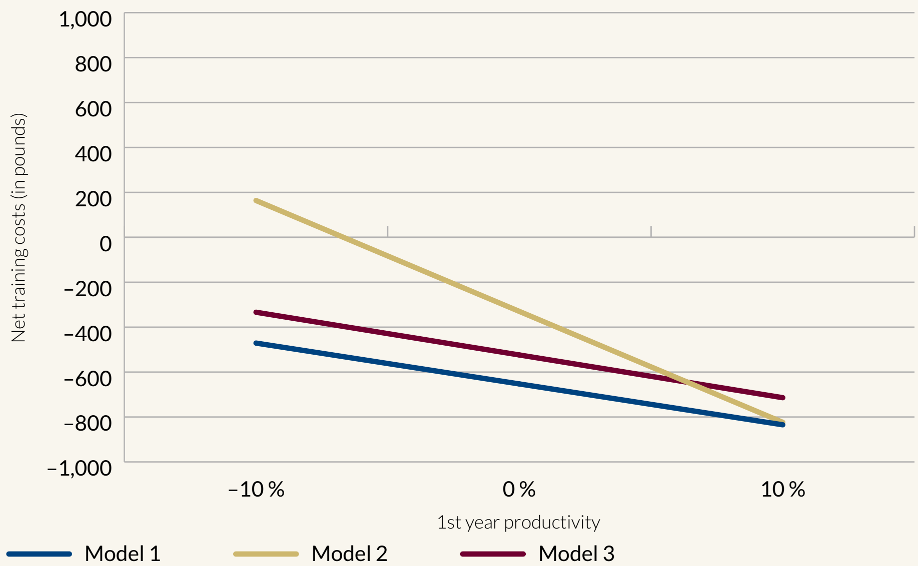
The purpose of training for the apprentices is to get hired as skilled workers at the end of their training period by either the training firm or an outside firm. In order to learn the necessary skills, they must not only follow a theoretical education but also be able to practice skilled work during their training. The benefit created for the firm by letting apprentices substitute skilled workers depends crucially on the relative performance (productivity) of apprentices compared to skilled workers. As we cannot directly measure the productivity of English apprentices, we use the levels of productivity of Swiss apprentices in our calculations. Thus, our estimates rely on the assumption that the relative productivity of apprentices in skilled tasks compared to experienced skilled workers (but not the absolute levels of productivity) would be the same for English and Swiss apprentices. This might be a good assumption to start with, but there are many reasons why in the real case of introducing a Swiss apprenticeship model in England, we would not see exactly the same levels of relative productivity. In Chapter 4, we described the factors that could either lead to higher or lower levels of relative productivity in England compared to Switzerland. Therefore, it is necessary to run sensitivity analyses in order to see by how much the net costs or net benefits of training would change if we deviated (+/– 10 percentage points in the first year of training[19]) from the Swiss assumptions about the relative productivity levels of apprentices.

£ 1,000 difference

The net costs in Model 2 (see Figure 4) react most sensitively to changes in the assumption about the relative productivity of apprentices. In this model, we assume that, due to their prior education and advanced age, firms substitute skilled workers with apprentices more quickly, and apprentices in turn begin to work at higher levels of productivity faster. In other words, compared to Models 1 and 3, the share of unskilled work in the first year would be much smaller, and therefore, the impact of changes in the relative productivity of apprentices doing skilled work on the benefit would be much greater. The changes, however, are still small even in Model 2, where an apprentice is 10 percentage points more productive relative to a skilled worker than a Swiss apprentice lowers the net costs by some £ 1,000 compared to one who is 10 percentage points less productive. For Models 1 and 3, the change is around £ 400, which should be negligible.

19 In Model 1 and 3 with a training duration of three years, we also change the second-year relative productivity by +/– 5 percentage points.

FIGURE 4 **Sensitivity analysis of apprentice productivity – Car mechanic England**



Source: own calculations with low wage scenario

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Break-even analysis for apprentice pay

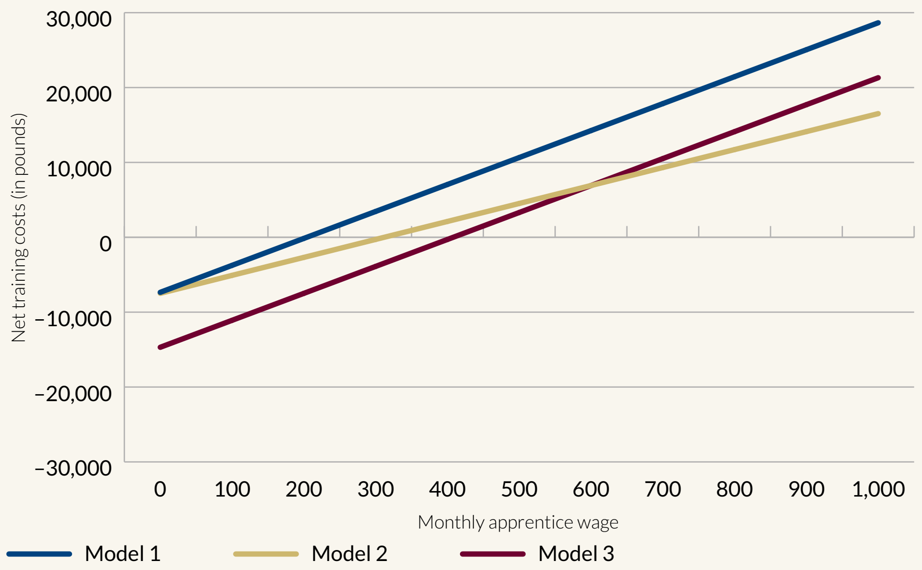
Break-even monthly pay between £ 200 and £ 400

The break-even analysis illustrates the linear relation between the apprentice's monthly wage and the firm's net training costs, holding all other factors constant. The break-even analysis serves the purpose of showing the salary level at which a firm would just have zero net costs in training apprentices. Additionally, it also helps to understand by how much the average apprentice pay would have to be increased or reduced if additional benefits or costs would accrue, although they are currently not included in our model. Technically, a £ 1 increase in the monthly apprentice wage leads to a £ 36 increase in net costs for Models 1 and 3 (36 months of training), while it results in £ 24 more net costs for Model 2 (24 months of training). Thus, apprentice pay is the decisive factor for a firm's cost-benefit ratio, and the sensitivity of the reaction of the net costs of training to changes in the salary is quite high.

Break-even pay below minimum wages

The calculation of the break-even wages shows (see Figure 5) that net training costs would be zero for monthly pays between £ 200 (Model 1) and £ 400 (Model 3). Although these break-even wages are below minimum wages in the UK for young workers, it has to be taken into account, that the firms have to pay for training, which lowers the break-even wages.

FIGURE 5 **Break-even analysis of apprentice wage – Car mechanic England**



Source: own calculations

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Break-even pay relative to skilled and unskilled wages

In relation to unskilled and skilled wages, the break-even wages (see Figure 6) would lay between 7 % and 20 % for each category. One can see from the calculations that, even relative to unskilled wages, break-even wages would need to be substantially below these wage levels for firms to be able to pay for their training expenditures. Taking into account the reflections on 'fair pay' (see Chapter 4, assumptions on wages), this is, however, not a surprise. Even if we excluded any training expenditure by the firms, a 'fair pay' for an apprentice relative to a skilled worker would need to take into account four factors that push the ratio down. First, an apprentice is not always working because he/she spends some time in off-site schooling. Second, when the apprentice is at the firm, he/she is not always working but also needs 'unproductive' time to practice. Third, when working, the apprentices is also doing unskilled work that would be remunerated at a lower pay level, and most importantly, when substituting a skilled worker, the apprentice works on average at a productivity level of 50 % compared to a skilled worker. The four factors taken together easily explain why the break-even wages even in the best cases do not surpass 15 % of an average wage for a skilled worker.

FIGURE 6 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Car mechanic England**

Source: own calculations

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Wage structure within a firm – how net costs differ by firm size

Firm size matters

While apprentice pay is an important cost component, the wage structure for low- and high-skilled workers also strongly affects the value of an apprentice's productive contribution (the benefit side). The value of having an apprentice work productively for one hour in an unskilled or skilled activity corresponds to the unskilled or skilled wage (adjusted for the relative productivity of the apprentice, as discussed in Chapter 4) for a worker of that particular firm. Thus, the higher the pay for unskilled and skilled workers, the more beneficial it is for a firm to use the trainee for productive work (all other things equal[20]). Firms differ not only by wage levels (which reflect differences in the overall productivity of the firm) but also in respect to the ratio between unskilled and skilled worker pay. Hence, the latter also determines a firm's optimal allocation of skilled and unskilled tasks to an apprentice.

Incentives to use apprentices for skilled tasks

To illustrate this in detail, let us consider the extreme and hypothetical case where unskilled and skilled pays are equal. In that scenario, a firm that wants to minimise net training costs will have an incentive to allocate as few skilled tasks as possible to the apprentice, because the productivity of an apprentice in skilled tasks is lower than the one of a skilled worker, while an apprentice – by definition – is equally productive in unskilled tasks compared to an unskilled worker. However, if unskilled pay is much lower than skilled pay, then a firm has an incentive to allocate skilled tasks to

20 A firm's provision of workplace training may depend on the firm size for various reasons and not only because of levels and differences between unskilled and skilled wages. Looking at the Swiss data, we find that the differences in the training hours provided to apprentices do not vary much by firm size, and this lack of variation is the reason why we assume in the simulations that all other factors besides the wage structure remain constant across firm sizes.

apprentices early on, so that their productivity in these tasks increases faster. Again, let us consider an extreme case where the productivity of an apprentice in the last year of training is equal to the one of a skilled worker. In this case, the firm's benefit from having the apprentice carry out the skilled tasks is simply the difference in hourly pay between the skilled worker and the apprentice, and by assuming that the skilled wage is higher than the unskilled wage, a firm will have no incentive at all to use apprentices for unskilled tasks anymore.

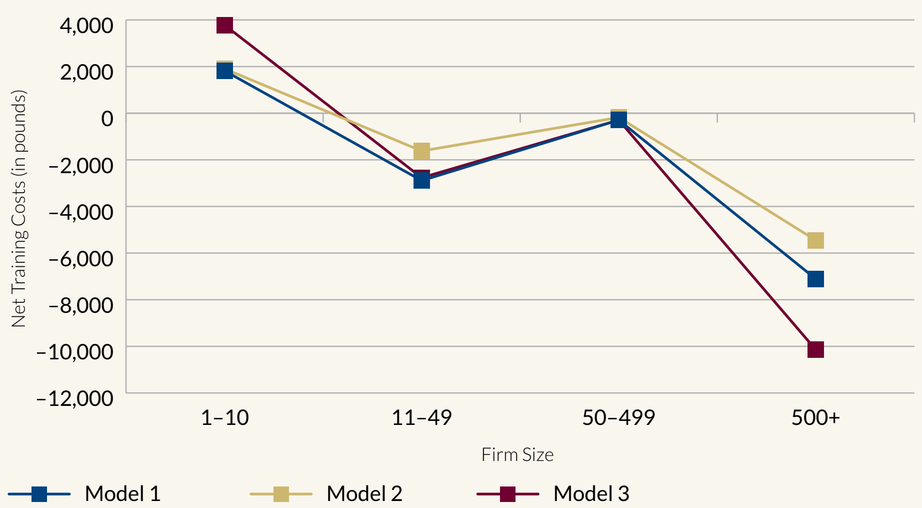
Skills premium higher for big firms

Looking at the UK wage data, we observe that the wage level in small firms is generally lower than in large firms, as it is the case in almost all countries. Moreover, the differences between skilled and unskilled pay is typically bigger in large firms. While unskilled workers also earn a little bit more in large firms compared to small firms, the firm size wage premium is typically higher for skilled workers than for unskilled workers.

Big firms could expect net benefits

As we assume in our simulations that firms pay the same apprentice pay irrespective of their size, the biggest impact on net costs comes from the differences in the absolute levels of pay and not so much from the relative pay of unskilled and skilled workers within a firm. The differences in pay levels between firms of the same sector but of different sizes lead to the result (see Figure 7) that very small garages training car mechanics have to encounter net costs in all three training models, even in the case of the low-wage scenario, whereas bigger firms can expect substantial net benefits. In reality, bigger firms usually do not pay the same apprentices' salaries as small firms, and this can lead to smaller differences in the net costs of training. However, the simulation shows that bigger firms have a scope to pay higher salaries for apprentices and thereby attract more talented youth.

FIGURE 7 **Net costs by firm size – Car mechanic England**



Source: own calculations, based on model 1 (low wage scenario)

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Micro firms face more difficulties

Conversely, very small firms would need to stick to the low pay scenario if they do not want to risk losing money in training apprentices. Additionally, very small firms face a higher risk of losing their trainees after the training period and therefore cannot factor in additional benefits after training. Although big firms could easily run a Swiss-type apprenticeship model given the UK wage structures, micro[21] firms would have difficulties doing so.

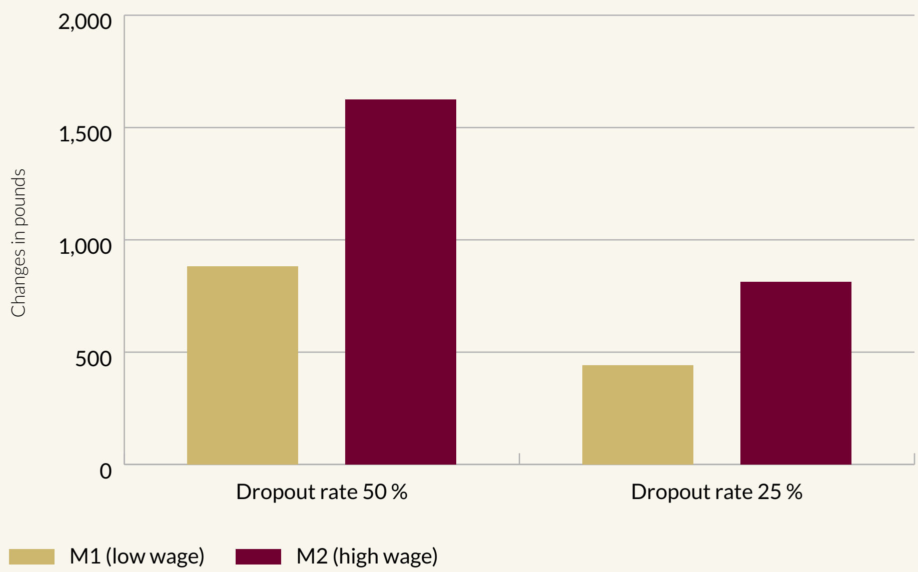
Dropouts increase the net costs

Finally, we analyze what impact apprentice dropouts would have on the net costs of training of one successful apprentice after the first year of training. Figure 8 compares our basic scenario with a zero dropout rate to calculations where every fourth (25 %) or every second (50 %) apprentice would quit the training program after the first year for Model 1 with low pay and for training Model 2 with high pay. Because in our simulations the training firm faces net costs after the first year, such dropout rates would increase the overall net costs per successful apprentice. If for every successful candidate, the firm had to train an unsuccessful one for one year, this would turn the small net benefit into net costs in Model 1 in the low-cost scenario, and increase net costs by more than £ 1,500 in the case of the high-pay scenario and training Model 2. As one can see, the additional costs training firms have to face in the case of dropouts depend on the training model, the net cost pattern over time, and most of all on the pay level for apprentices, and such costs can be substantial.

Reputational risks

Besides the financial costs that dropouts generate for training firms, there would certainly also be a negative psychological factor affecting the willingness to train and, as mentioned before, a reputational damage to take into account.

FIGURE 8 **Changes in net-costs assuming different dropout rates – Car mechanic England**



Source: own calculations

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21 We call SME's with less than 10 employees 'micro' firms.

6 Results of a simulation of private rates of return to education for apprentices

Does it pay off for apprentices?

Observing that all wage scenarios (low, high, and break-even) assume apprenticeship wages that are only a small fraction of unskilled and skilled wages, a question arises as to whether training is worthwhile for the apprentices at such levels of apprentice pay. The lower the pay during the training period and the longer the duration of the apprenticeship program, the higher the wage differential between the unskilled and the skilled wage must be for the rest of the working life to generate a positive return to education.

Simulations using break-even wages

Calculations of the returns to education are quite frequent (see Cavaglia et al. 2017 for a recent example of calculations of private rates of return to education for English apprenticeship programs). Although we are using real labour market data on UK wages in this study, we need to simulate these rates of return to education because these calculations should mirror our assumptions in the cost-benefit simulations for firms. In other words, we need to simulate whether apprentices can expect positive returns to education if they follow an apprenticeship as designed in our models and are paid the apprentices wage as assumed in the cost-benefit simulations for firms. The results shown in Table 3 use the break-even wages calculated for all models and occupations. In the break-even scenario, firms would not incur net costs after training and would therefore not need to rely on additional benefits after training. Thus it is most interesting to see whether scenarios that are attractive for firms to offer apprenticeships are also attractive for potential apprentices.

Additional assumptions

For the calculations of the rates of return to education for apprentices, we need to make a couple of additional assumptions. According to one assumption, the alternative wage for a young person who chooses to forego an apprenticeship would be the wage for unskilled personnel in the same economic sector as the apprenticeship. A stronger assumption, however, is that we use the current wage levels of skilled people as the expected wages after training. We chose to use this assumption as a lower bound for our calculations, presuming that a student facing the decision to start an apprenticeship does not use the current wage levels observed for trained workers as the benchmark in his/her decision process. We could, of course, assume that if English apprentices were trained similarly to Swiss apprentices, their levels of productivity would increase compared to workers in the same occupations in England today and they would earn a skill premium. For the firms – as described above – changes in the assumptions influencing the impact of training on skilled wages do not alter the net costs of training much, whereas for the apprentices, such increases would translate directly in higher rates of return to education. However, we cannot know by how much the productivity of apprentices would rise in reality or how such increases would translate into higher salaries for skilled workers. For these reasons, we chose to stick with the conservative assumption that, in the short run, wage levels for skilled people would not change.

Lifetime earnings

The calculations were made by using the average salaries per occupation and sector for skilled and unskilled workers. We transform these averages into lifetime earning streams with a convex shape using information about the impact of experience (and experience squared) from so-called Mincer earnings regressions (e.g., Polachek 2008). We thus assume that wages increase steeply in the first years of working life, flatten in the middle, and may even decrease towards the retirement. We then calculate the interest rate that would be needed to equalise the income stream for the unskilled and the skilled person for each of the occupations and models.

Rates of return depend on the duration of training models

The rates of return to education differ between the models not only because of differences in the apprentice pay but also because in Model 1 we assume that apprentices start their apprenticeship directly after finishing lower secondary education and earn the skilled wage afterwards till the end of their working life. Conversely, in Model 2 and 3 the apprentices would spend an additional three years in upper-secondary education (without pay), which shortens the time available to earn the skilled wage. Rates of return to education differ between the occupation mainly because of the different skill premium observed today on the UK labour market and, to a small extent, because of different break-even wages paid during the apprenticeship.

Rate of return should exceed time preferences

From the empirical literature, we know that most people have rates of time preference above 5 %. In other words, they prefer an instant reward to a later payment, even if the later comes with a surplus of 5 %. Reading the results in Table 3, we therefore interpret rates of return to education that do not exceed 5 % as critical (numbers in bold in table 3), because these rates of return to education would most probably be too small to attract average students.

TABLE 3 **Rates of return to education in percent – break-even wage scenario for firms**

Occupations	Model 1	Model 2	Model 3
Bricklayers	19 %	11 %	9 %
Car mechanics	13 %	9 %	7 %
Care workers	8 %	**4 %**	**3 %**
Commercial bank employees	18 %	11 %	10 %
Cooks	7 %	**4 %**	**3 %**
Electricians	7 %	**4 %**	**3 %**
Financial analysts and advisors	12 %	8 %	7 %
IT/software developer	17 %	11 %	10 %
Retail cashiers	**4 %**	**2 %**	**1 %**
Waitress and waiters	**5 %**	**2 %**	**2 %**

Source: own calculations, bold numbers show rates that do not surpass the threshold of 5 %.

High returns for individuals in most occupations

With the exception of retail cashiers and waiters, apprenticeships of the Model 1 type generate rates of return to education that are sufficiently high. In Models 2 and 3, the rates of return to education fall below the critical threshold of 5 % for the occupations care workers, cooks, and electricians.[22] For five out of the ten occupations which we used to simulate the costs and benefits of training for firms, apprentice pay guaranteeing zero net costs for the firms would be too low to generate rates of return to education for apprentices that we consider high enough to attract sufficiently talented youth into these programs.

22 The heterogeneity in the rates and the low rates of return to education, in particular for occupations in the service sector, are not surprising, and our simulations correspond more or less to findings that have calculated observable rates of return: 'The average differential is strongly dependent on the sector chosen with the differential being strongest for engineering. ... At the opposite extreme, there are apprenticeship sectors that have a negligible or lower premium than alternatives for people educated to the same level. This includes having an apprenticeship in service enterprises (such as hairdressing) for women educated to level 2 or level 3 and childcare at level 3 (also affecting women). Thus, much like university degrees, one should think of the potential 'returns' to an apprenticeship as being variable across subject specialism' (Cavaglia et al. 2017, p.59).

7 Summary analyses of the results

Summary of results

Table 4 provides a summary of the results of the net cost simulations for all occupations and scenarios. We put in red all of the net costs that are above £ 2,000 and in light green all of the net costs or net benefits within a bandwidth of +/– £ 2,000. As we can easily see from the colour pattern, the net costs in all models using the low-wage scenario are (with one exception) in green or light green, whereas, in the high-wage scenario, about half of the occupations and models show red, meaning net costs in the range of about one monthly salary or more of a skilled worker. If we observe substantial net costs in the models under the high-wage scenario, then the break-even salaries will be below the salary used for this scenario and vice versa.

Explanations for high net benefits

In the cases where net benefits are extremely high, that is for bricklayers, electricians, and IT/software developers, the reasons are as follows. For bricklayers and IT/software developers, the main reason lies in the relation of apprentices pay (in the low-wage scenario) and productivity of apprentices. Moving to the high-cost scenario reduces the net benefits substantially. For electricians, the main reason is the high share of skilled work with high levels of productivity (data collected from the underlying Swiss observations). Apprentices in this occupation tend to be highly productive during the early phase their apprenticeship. In the case of electricians, however, this productivity does not automatically lead to higher apprentice pay (see the calculations for break-even wages in the appendix) or to high net cash benefits for the training firms. The high productivity and low costs are used by firms to gain customer contracts because they can offer their services at lower costs than competitors that do not employ and train apprentices. Therefore, a substantial part of the net benefit shown here is actually a gain for the customers. However, in the case of electricians in England, the private rates of return to education (see table 3) are not extremely high, and therefore, it is likely that a part of the substantial net benefits that training firms could expect should be used for higher apprentice salaries, and better training should also lead to a higher wage differential between skilled and unskilled electricians.

Explanations for high net costs

Different explanations are needed for the cases where net costs in the high-wage scenario are extremely high, as it is the case for car mechanics, commercial bank employees, cooks, retail cashiers, and waiters. In the case of car mechanics and cooks, it is mainly the high share of practicing that reduces the benefits and would therefore legitimate a lower wage than assumed in the high-wage scenario. In the case of commercial bank employees, it is the costs of training that would justify a lower pay, and in the cases of care workers, retail cashiers, and waiters, it is the low level of salaries as well as the small differential between unskilled and skilled salaries that pushes down the break-even salaries. If the wage differential between skilled and unskilled salaries is small, then the productive contribution of apprentices, when substituting skilled labour at low productivity rates, is also very low. If, however, the wage differential is big, then a firm earns more when letting the apprentice substitute skilled workers instead of executing unskilled work even at low productivity rates in the first year(s) of the apprenticeship training. To give an idea of the heterogeneity in the wage data used for these simulations, we used the skill premium (the ratio between skilled workers in the occupation and unskilled workers in the same economic sector(s)) that ranges from almost 50 % for IT/software developers to just 10–15 % for care workers, retail cashiers, and waiters.

TABLE 4 **Net training costs and saved hiring costs for all occupations and scenarios England**

	Low wage scenario			High wage scenario		
Occupation	M1	M2	M3	M1	M2	M3
Bricklayers	–10,755	–6,816	–12,102	–4,901	–1,427	–2,194
Car mechanics	–653	–330	–524	6,790	6,018	12,067
Care workers	–6,073	–2,244	–2,845	–1,567	2,153	5,076
Commercial bank employees	–2,523	51	–1,511	2,439	4,889	7,181
Cooks	–3,598	–1,275	–1,758	1,716	3,827	7,474
Electricians	–17,717	–10,009	–18,876	–12,803	–5,315	–10,419
Financial analysts and advisors	–8,803	–6,401	–14,943	–3,701	–1,646	–6,225
IT/software developer	–6,722	–5,477	–12,201	–1,711	–1,182	–3,875
Retail cashiers	–3,693	–701	–121	689	3,349	7,339
Waitress and waiters	–1,088	1,792	3,853	3,050	5,742	11,007

Source: own calculations

Potential savings in hiring costs

The net costs in Table 4 are calculated at the end of the training period, and because additional benefits can accrue after this point, we compare these net costs in Table 5 with potential savings in hiring costs if the firm is able to keep the apprentices after the training contract has ended. Because we have no representative observational data, we compare the net costs with hypothetical savings in hiring costs. Scenario 1 (HC 1) for the savings in hiring costs is based on the assumption that a firm can save up to four monthly salaries of a skilled employee by not having to hire or instruct someone from the labour market. However, the firm is only able to retain half of the trained apprentices, which reduces the potentially saved hiring costs to the equivalent of two months' salary of a skilled employee. In scenario 2 (HC 2), we assume that a firm is able to retain all the trained apprentices. Because firms could expect a net benefit in almost all the occupations given the low-wage scenario or Model 1 in the high-wage scenario, we compare the saved hiring costs with Model 2 in the high-wage scenario. Green shows all the cases where there is already a net benefit by the end of the training period or where potential savings in hiring costs would cover the net costs incurred. Light red highlights the cases where the savings fall just short covering the net costs, and red highlights the cases where the hiring costs do not cover the net costs.

TABLE 5 **Net training costs (high wage scenario), potential savings in hiring costs and rates of return to education for apprentices England**

Occupation	M2	HC (1)	HC (2)	RR (M2)
Bricklayers[1)]	–1,427			
Car mechanics	6,018			
Care workers	2,153			
Commercial bank employees	4,889			
Cooks	3,827			
Electricians	–5,315			
Financial analysts and advisors	–1,646			
IT/software developer	–1,182			
Retail cashiers	3,349			
Waitress and waiters	5,742			

1) Bricklayers are a particular case as concern hiring costs. They are mainly hired on construction sites as 'self-employed' and paid at a piece-rate, which means that there are no hiring costs for the building contractors and if their productivity is low, the contractors are not going to lose money.
Source: own calculations

Motivations to train in occupations with net costs

With the exception of waiters, in all occupations, the savings in hiring costs have the potential to cover the net costs in a more expensive training model, provided the firms are able to retain their apprentices after training. In the final step, we compare the perspective of the firm to the one of potential apprentices (see RR M2). Green shows all the cases where the rate of return to education is above and light red when the rate of return is just around 5 %. The calculations are made for the high-wage scenario and the training parameters of Model 2. The comparison of net costs for firms (including potential savings in hiring costs) and the rates of return to education for apprentices shows that, in the case of electricians, the firms should have the scope to raise the salary levels for apprentices such that these could expect sufficiently high rates of return. In the cases of care workers, retail cashiers, and waiters, however, the room of manoeuvre is likely to be limited, in particular for the latter. In other words, the training models for which we have made simulations would not allow firms and apprentices to gain sufficiently, and therefore, the willingness of the firms or potential apprentices to train or receive training in these occupations according to these parameters would be low. Furthermore, because savings on the side of firms like reduced training expenditures or lower salaries would further reduce the expected returns of apprentices, changes of this nature would not produce the desired outcomes. Two options would exist, however, to find a way to increase the attractiveness in these occupations. The first option would be for potential apprentices to accept low salaries during training and for firms to invest sufficiently in training allowing the apprentices to expect skilled wages that are above the levels observed on the UK labour market today. Firms would not incur higher net costs and therefore not need to fear poaching from competitors. Additionally, the potential apprentices could compensate the lower salaries during training through better salary perspective for the following years of their professional life. The second option would be for firms to accept net costs during training but to look at it as an investment in future middle management positions, where hiring costs are substantially higher than for lower level positions. In this option, firms would consider their apprentices as the potential future middle managers and the net costs of training apprentices as the necessary investment into this group of employees. In this case, firms would of course have to fear poaching from competitors and therefore would need to make some extra arrangements to prevent high turnover rates of their trained apprentices, including the provision of firm-specific human capital.

8 Conclusions and recommendations based on the analyses

Representation of the results

The simulated cost and benefits of apprenticeship training in this study show the potential outcomes for firms from the hypothetical situation in which firms in England adopt an apprenticeship-training model that roughly follows the Swiss one. Not surprisingly, these simulated costs and benefits show a considerable heterogeneity due to differences in the results per occupation in the Swiss data and to variations in the wage differentials between unskilled and skilled workers in the ten occupations. Thus, the question whether a training firm would have to expect net costs or could rather enjoy a net benefit when applying a Swiss-like training model depends on many factors that will differ from one occupation to another. Furthermore, the simulations show that, within a given occupation, results may vary considerably between firms of different sizes.[23] In any case, the simulations show that policies targeted to increase the number of apprenticeships would need to take into account these heterogeneities between occupations, firms, and regions.

Five main results

The five main conclusions that we can further draw from our simulations are the following:

Net benefits when training younger apprentices

1) As firms operate with minimum salaries in all our simulations, their chances for of breaking even at the end of the training period are highest for three-year programs assuming that the apprentices are younger than 19 years[24] of age for all occupations, because minimum wages increase substantially afterwards. Therefore, apprenticeships for young people as an alternative to school-based general education or school-based vocational training may produce the best outcomes from the perspective of firms. In some occupations, training firms can even have some scope to go beyond national minimum wages and thereby also increase the returns of apprentices to education.

Individual rates of return higher when younger

2) From the perspective of apprentices, the programs that would start at an early age, even at a very low pay, would in most cases also generate the highest private rates of return, compared to scenarios, where the apprentices follow a program at a later age.

Big firms could expect higher net benefits

3) In most occupations and scenarios, big firms have the highest net benefits, whereas micro-companies may sometimes even face net costs in scenarios where the average firm can expect net benefits. In sectors where micro companies are the backbone of the industry, particular policy measures to stimulate firms’ engagement would be warranted, whereas bigger firms often do not need special stimuli. The differences

23 The results would certainly also vary between regions, but we have used national averages throughout our simulations.

24 The assumption about the age is relevant because of the age dependent differences of the current minimum wage regulations in the UK.

in the net costs or net benefits between firms of different sizes in our simulations lie in the fact that the product of different absolute pay levels and different relative wages between skilled and unskilled workers. In reality, however, micro companies would also have additional disadvantages due to the absence of economies of scale. Some of the training costs and entry costs into the programs as such are fixed costs, independent of the number of trained apprentices. This situation, in turn, favours bigger firms that can spread these costs over many apprentices.

Training for middle management positions

4) In most of the ten occupations, at least one or two models and scenario produce net benefits or firms can expect saved hiring costs that could offset net costs. Yet three occupations in the service and hospitality sector (cooks, retail cashiers, and waiters) produce simulation outcomes that show difficulties for firms to break even, and at the same time, private rates of return to education for the apprentices are very low. In the three cases, the skill premium observable today in the UK labour market is too low to guarantee favourable outcomes for firms and apprentices. In these occupations and sectors, one would need to see whether an improved quality of training would increase the workers' productivity and wages sufficiently to make the training investment worthwhile for firms and potential apprentices. For apprentices, an increase in relative wages of skilled employees compared to unskilled workers would automatically increase the private rates of return to education. For firms, however, this would only improve the cost-benefit situation in the long run if the improved quality of training would help them to increase their competitiveness and more directly lower their hiring costs for middle management functions. For the latter, this would require firms to retain a substantial number of their trainees. However, the research literature and empirical observations show that an increase of training quality also improves loyalty of employees and thereby reduces turnover rates.

Increases in the quality of training crucial

5) Improvements in the quality of training programs that would improve the labour market outcomes of apprentices could be a necessity to secure talented applicants for the programs and thereby also reduce dropout rates. The latter may hamper the willingness of firms to train in some occupations because they increase the net costs of training. Such situation is particularly likely in the high-wage scenarios for apprentices and training structures, where apprentices may need certain time to become productive.

Increases in quality can create a win-win situation for firms and apprentices

In sum, one of the major challenges for a successful expansion of an apprenticeship training system in England that will create a win-win situation for firms and apprentices is a quality improvement in programs. For some of the occupations (see point 4 of the conclusions), training that translates into substantial increases in productivity compared to the current situation is needed to make these programs attractive for both potential training firms and apprentices. If the apprentices and the skilled employees thereafter became more productive, this would make it a) financially more attractive for firms to use apprentices for skilled work during training and thereby increase the training quality again and b) guarantee that graduates of these apprenticeships would enjoy a considerably higher skills wage premium observable in today's labour market. In the latter case, the higher private rates of return to education should attract more talented candidates into these apprenticeships, which in turn would again improve the cost-benefit balance for training firms.

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Appendices

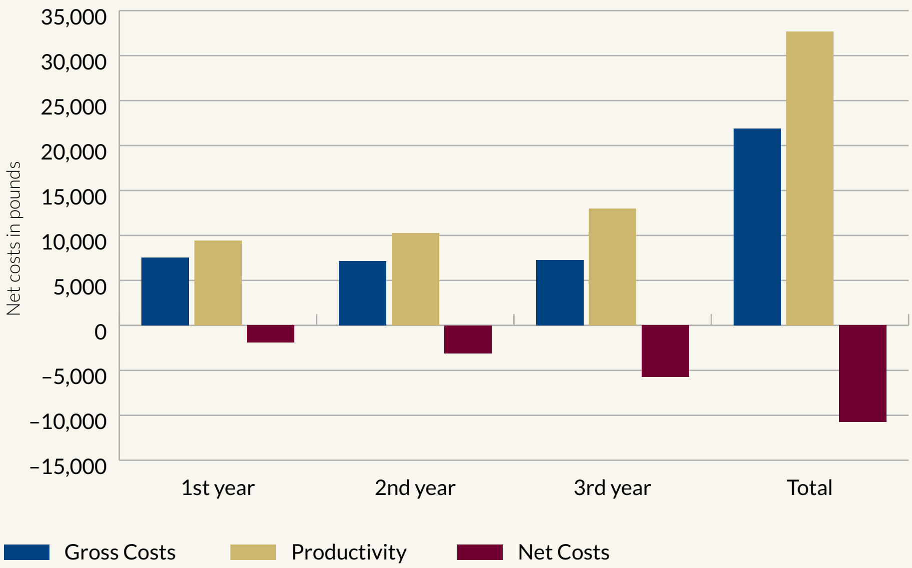
Bricklayers

TABLE A1 **Net training costs – Bricklayers England**

Wage	Model 1	Model 2	Model 3
low	–10,755	–6,816	–12,102
high	–4,901	–1,427	–2,194

Source: own calculations

FIGURE A1 **Gross costs, productivity, and net training costs by year of training – Bricklayers England**



Source: own calculations, based on model 1 (low wage scenario)

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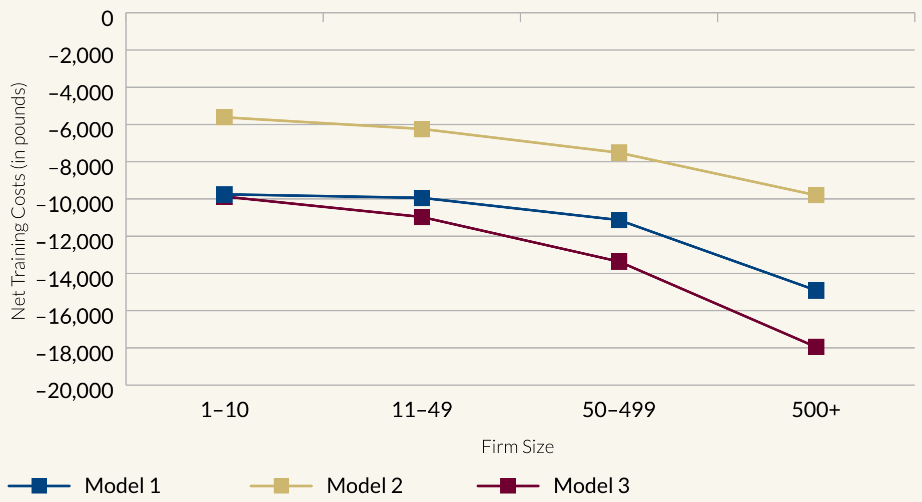
FIGURE A2 **Net costs by firm size – Bricklayers England**



Source: own calculations, based on model 1 (low wage scenario)

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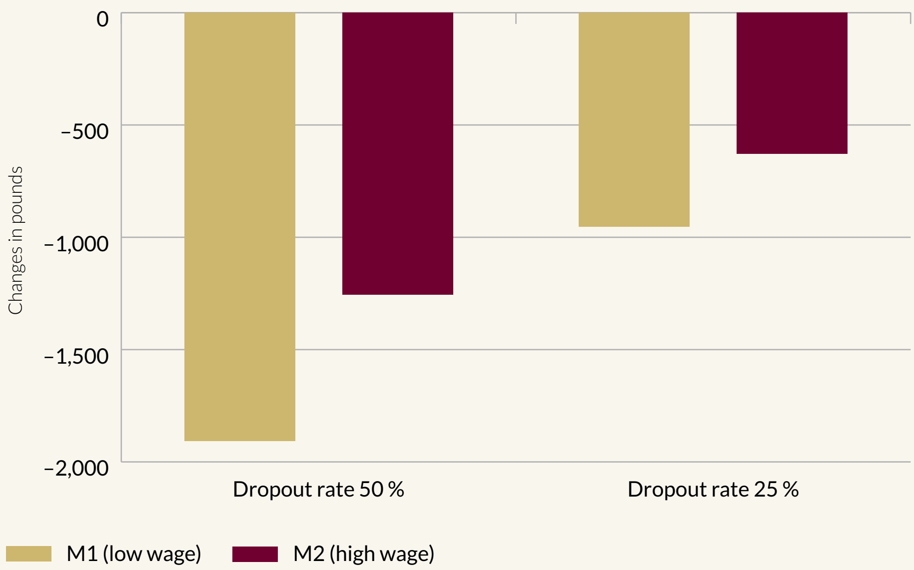
FIGURE A3 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Bricklayers England**

Source: own calculations

BertelsmannStiftung

FIGURE A4 **Net costs assuming different dropout rates – Bricklayers England**



Source: own calculations

BertelsmannStiftung

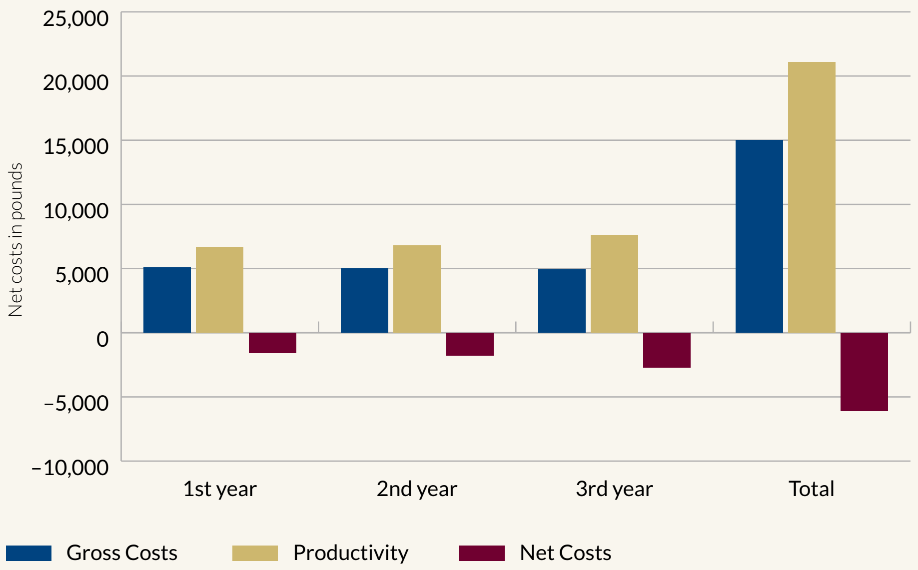
Care Workers

TABLE A2 **Net training costs – Care Workers England**

Wage	Model 1	Model 2	Model 3
low	–6,073	–2,244	–2,845
high	–1,567	2,153	5,076

Source: own calculations

FIGURE A5 **Gross costs, productivity, and net training costs by year of training – Care Workers England**



Source: own calculations, based on model 1 (low wage scenario)

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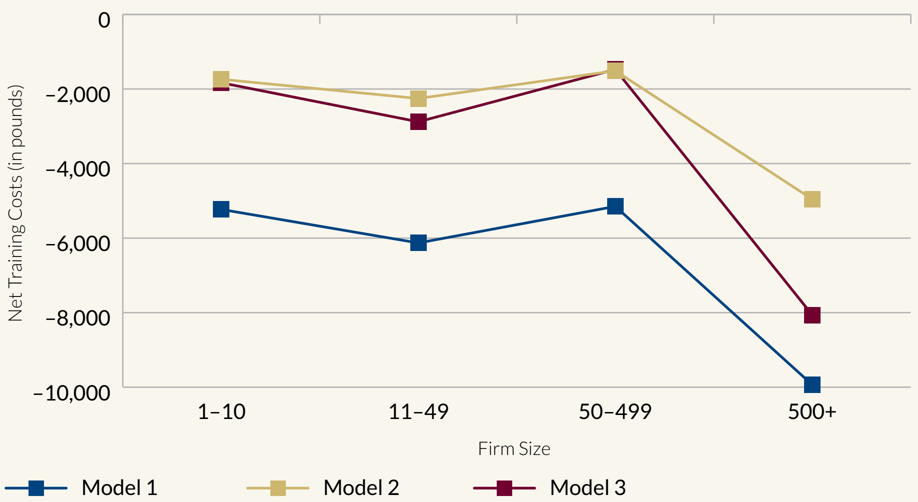
FIGURE A6 **Net costs by firm size – Care Workers England**



Source: own calculations, based on model 1 (low wage scenario)

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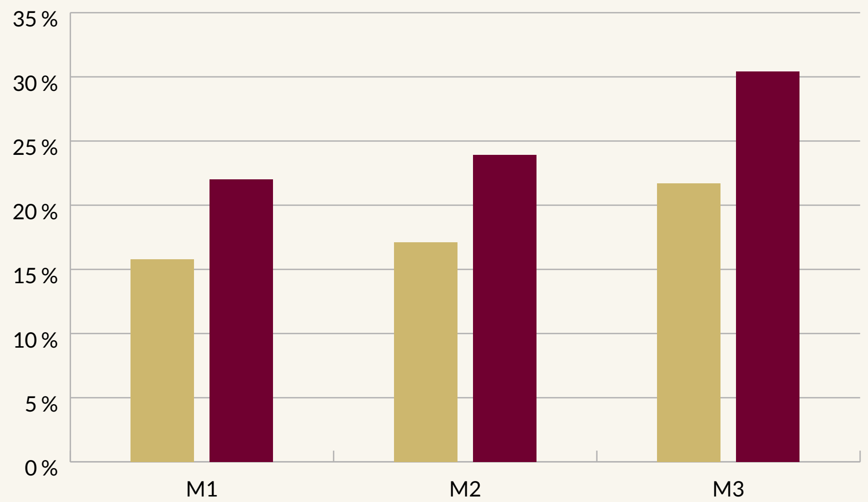
FIGURE A7 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Care Workers England**

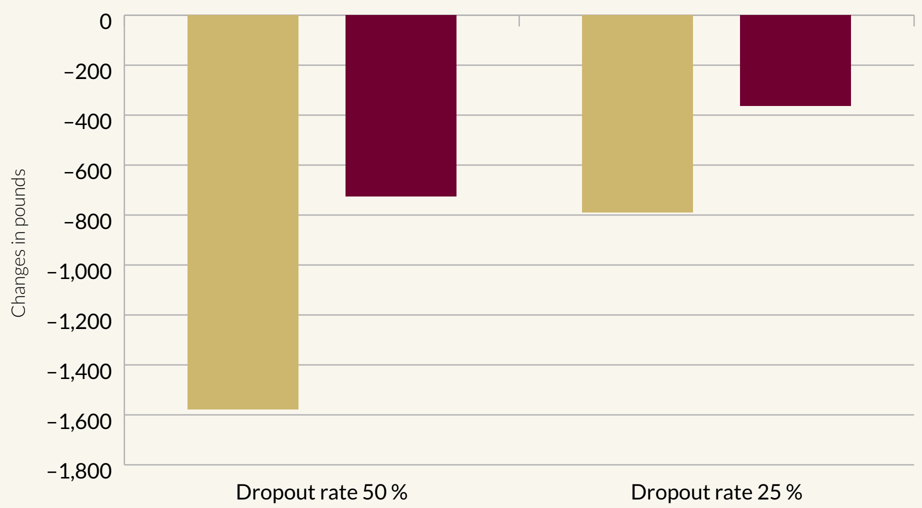


Share of skilled worker wage   Unskilled worker wage

Source: own calculations

BertelsmannStiftung

FIGURE A8 **Net costs assuming different dropout rates – Care Workers England**



M1 (low wage)   M2 (high wage)

Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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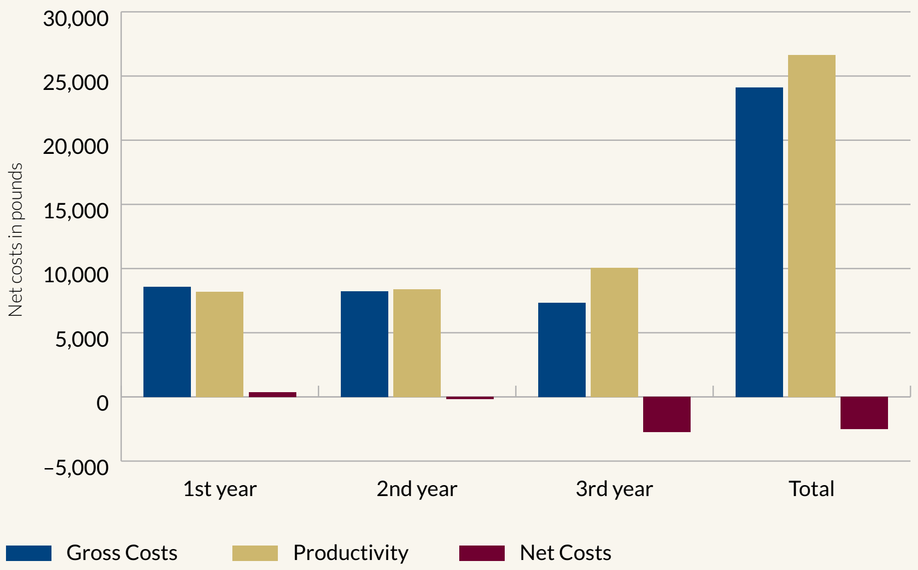
Commercial Bank Employees

TABLE A3 **Net training costs – Commercial Bank Employee England**

Wage	Model 1	Model 2	Model 3
low	–2,523	51	–1,511
high	2,439	4,889	7,181

Source: own calculations

FIGURE A9 **Gross costs, productivity, and net training costs by year of training – Commercial Bank Employee England**



Source: own calculations, based on model 1 (low wage scenario)

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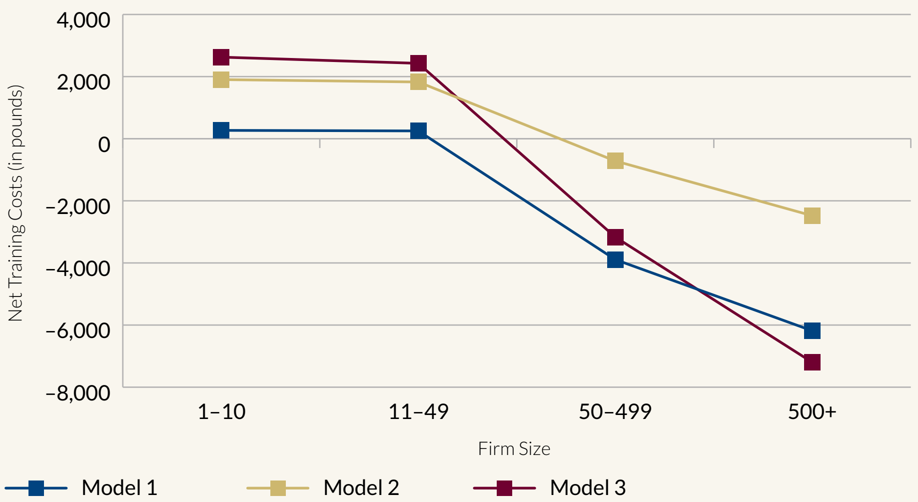
FIGURE A10 **Net costs by firm size – Commercial Bank Employee England**



Source: own calculations, based on model 1 (low wage scenario)

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FIGURE A11 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Commercial Bank Employee England**

Source: own calculations

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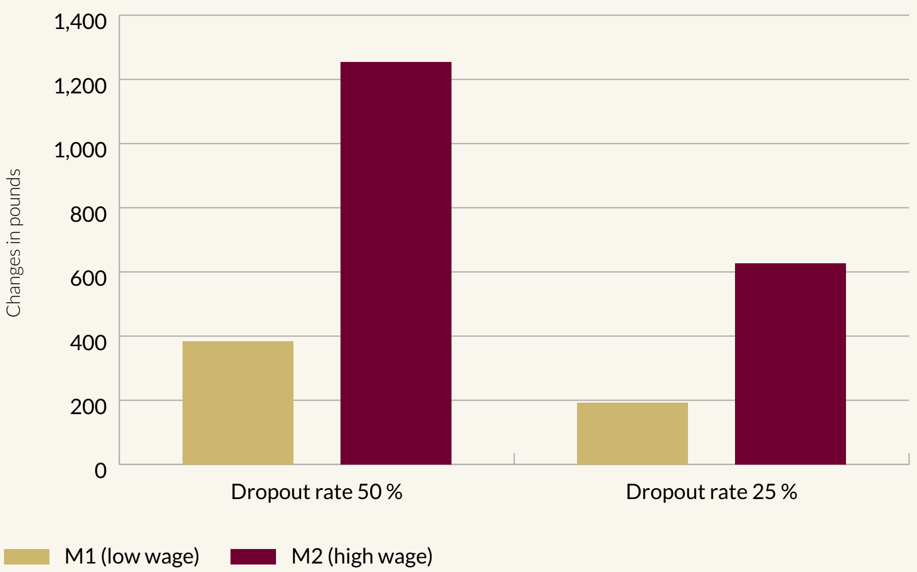
FIGURE A12 **Net costs assuming different dropout rates – Commercial Bank Employee England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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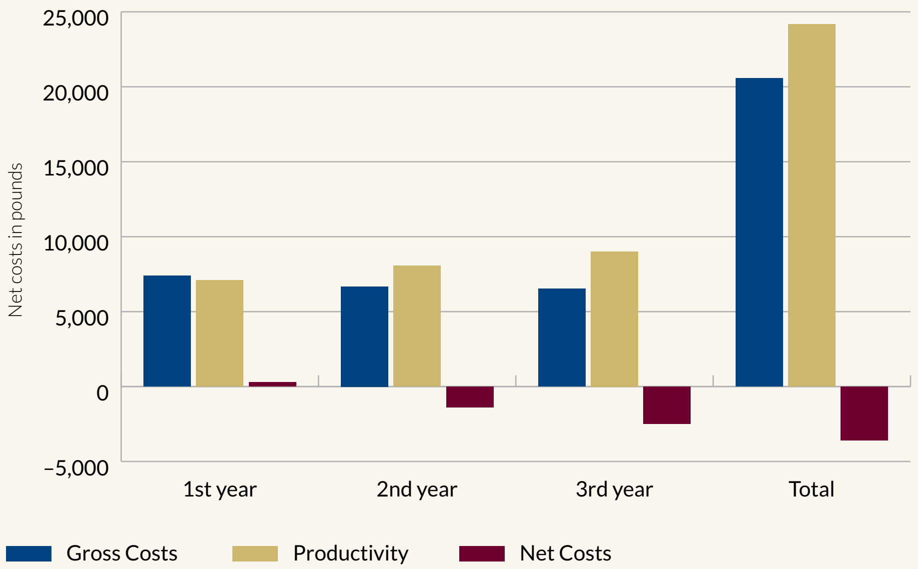
Cooks

TABLE A4 **Net training costs – Cooks England**

Wage	Model 1	Model 2	Model 3
low	–3,598	–1,275	–1,758
high	1,716	3,827	7,474

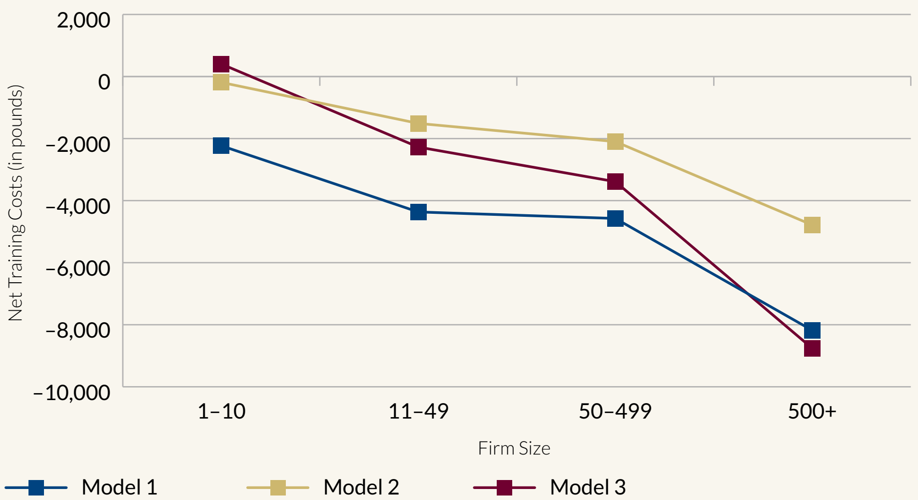
Source: own calculations

FIGURE A13 **Gross costs, productivity, and net training costs by year of training – Cooks England**



Source: own calculations, based on model 1 (low wage scenario) | BertelsmannStiftung

FIGURE A14 **Net costs by firm size – Cooks England**

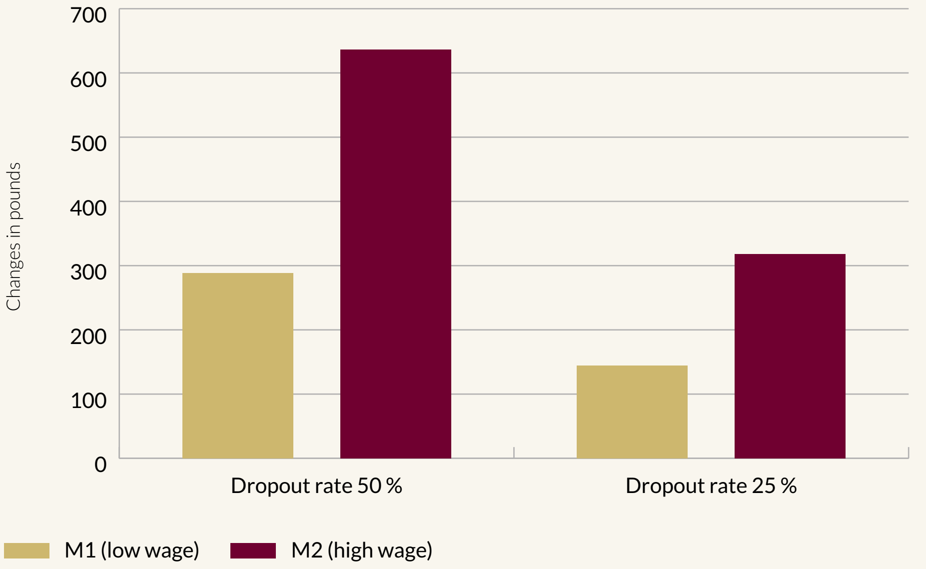


Source: own calculations, based on model 1 (low wage scenario) | BertelsmannStiftung

FIGURE A15 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Cooks England**

Source: own calculations | BertelsmannStiftung

FIGURE A16 **Net costs assuming different dropout rates – Cooks England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario). | BertelsmannStiftung

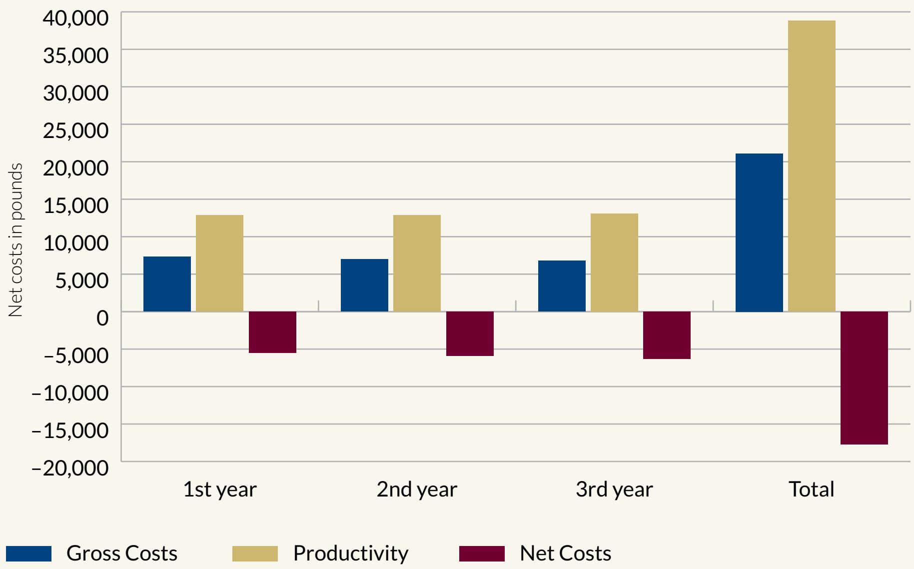
Electricians

TABLE A5 **Net training costs – Electricians England**

Wage	Model 1	Model 2	Model 3
low	–17,717	–10,009	–18,876
high	–12,803	–5,315	–10,419

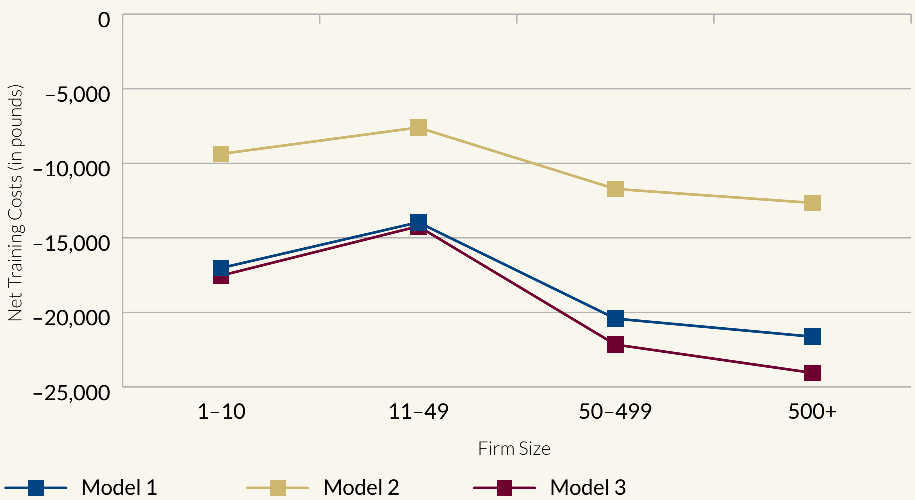
Source: own calculations

FIGURE A17 **Gross costs, productivity, and net training costs by year of training – Electricians England**



Source: own calculations, based on model 1 (low wage scenario) | BertelsmannStiftung

FIGURE A18 **Net costs by firm size – Electricians England**



Source: own calculations, based on model 1 (low wage scenario) | BertelsmannStiftung

FIGURE A19 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Electricians England**

Source: own calculations

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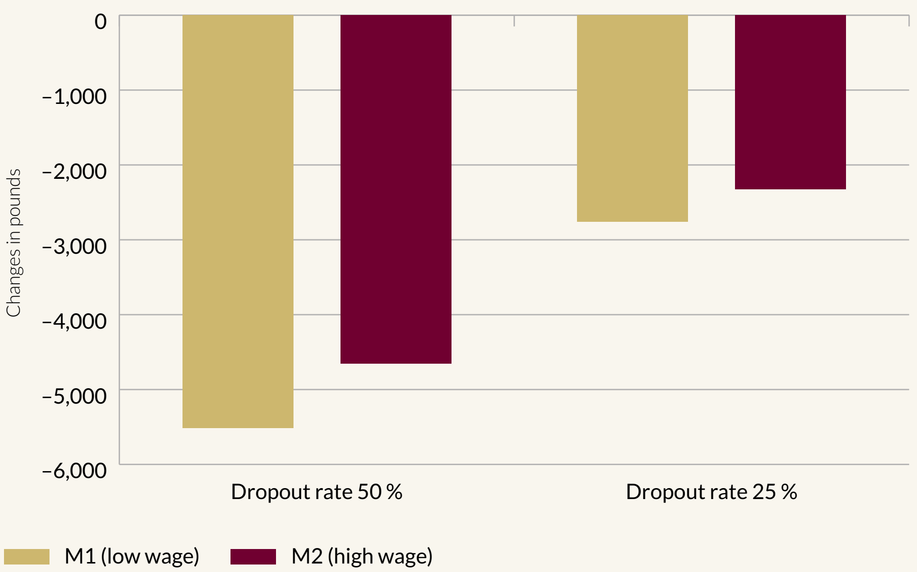
FIGURE A20 **Net costs assuming different dropout rates – Electricians England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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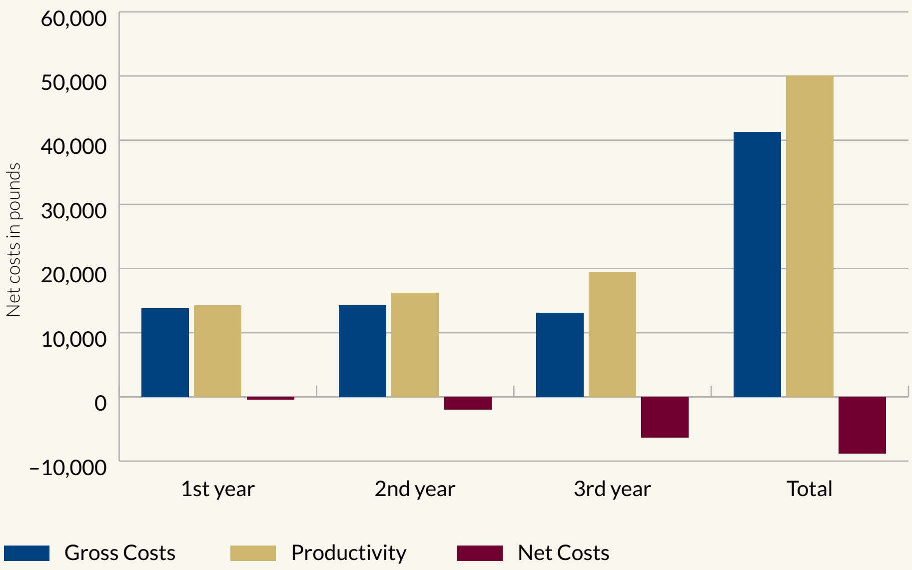
Financial Analysts and Advisors

TABLE A6 **Net training costs – Financial Analysts and Advisors England**

Wage	Model 1	Model 2	Model 3
low	–8,803	–6,401	–14,943
high	–3,701	–1,646	–6,225

Source: own calculations

FIGURE A21 **Gross costs, productivity, and net training costs by year of training – Financial Analysts and Advisors England**



Source: own calculations, based on model 1 (low wage scenario)

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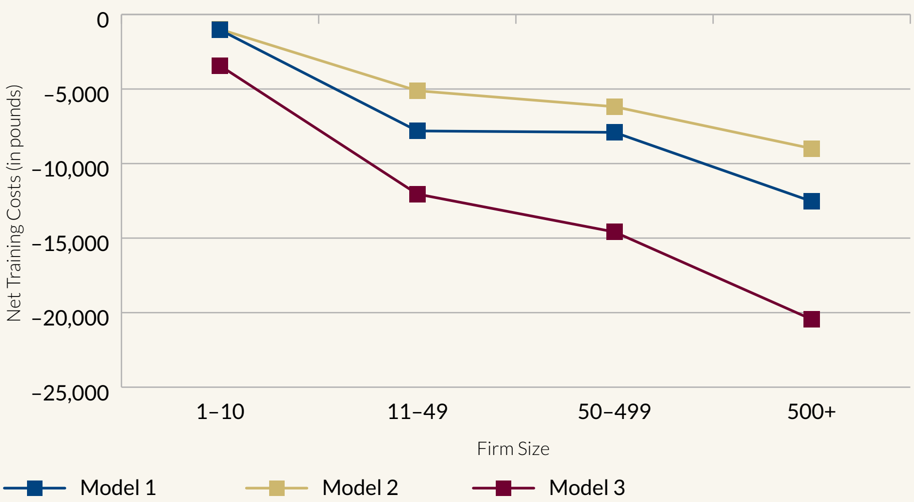
FIGURE A22 **Net costs by firm size – Financial Analysts and Advisors England**



Source: own calculations, based on model 1 (low wage scenario)

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FIGURE A23 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Financial Analysts and Advisors England**

Source: own calculations

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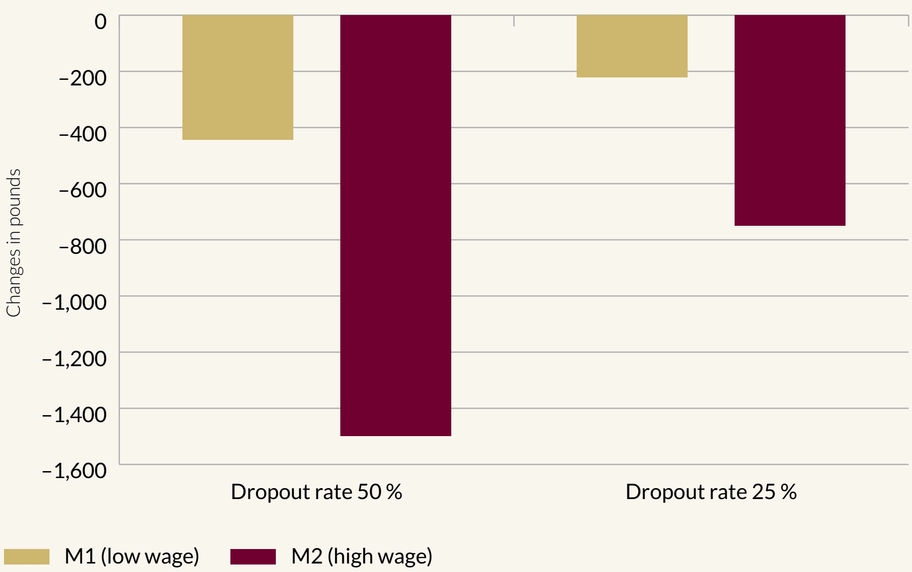
FIGURE A24 **Net costs assuming different dropout rates – Financial Analysts and Advisors England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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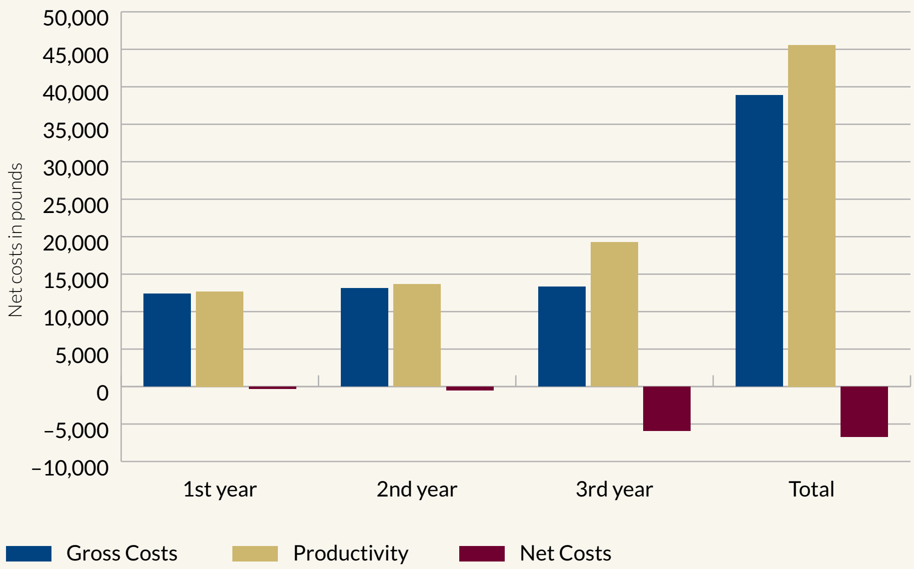
IT and software developers

TABLE A7 **Net training costs – IT and Software Developers England**

Wage	Model 1	Model 2	Model 3
low	–6,722	–5,477	–12,201
high	–1,711	–1,182	–3,875

Source: own calculations

FIGURE A25 **Gross costs, productivity, and net training costs by year of training – IT and Software Developers England**



Source: own calculations, based on model 1 (low wage scenario)

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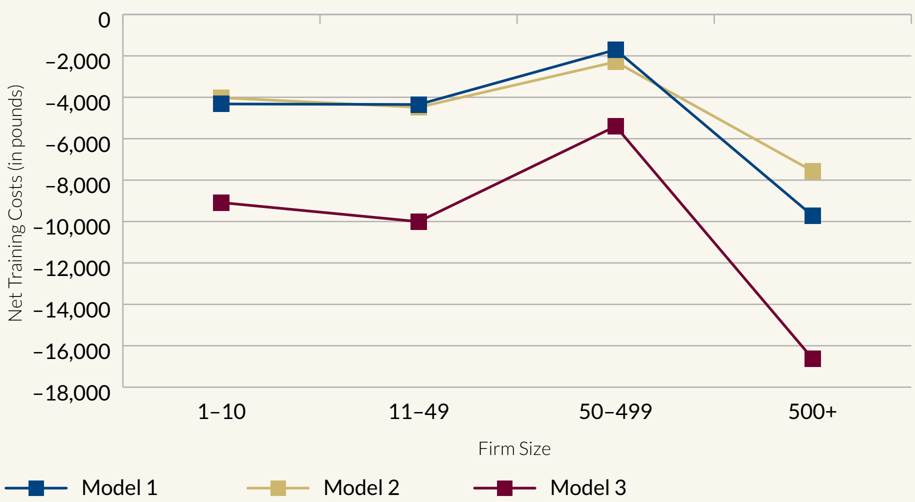
FIGURE A26 **Net costs by firm size – IT and Software Developers England**



Source: own calculations, based on model 1 (low wage scenario)

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FIGURE A27 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – IT and Software Developers England**

Source: own calculations

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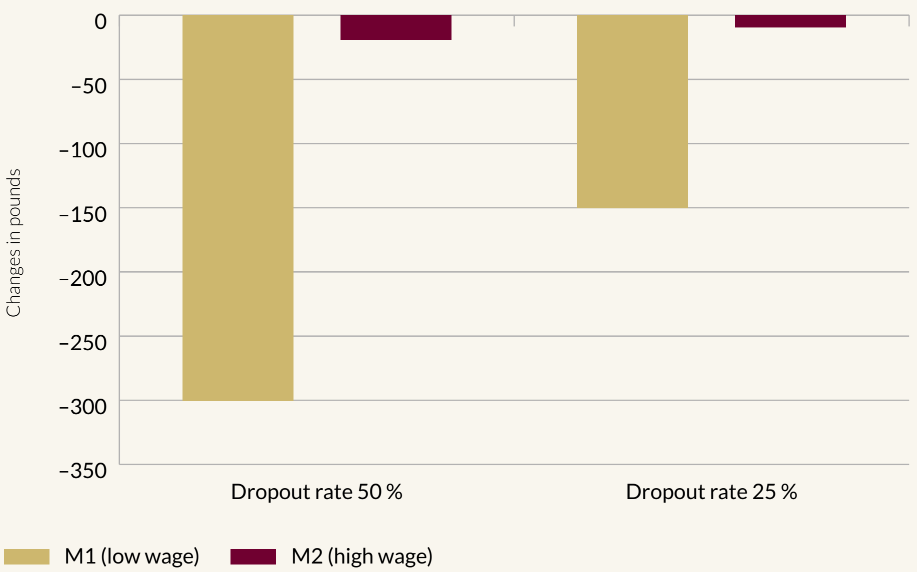
FIGURE A28 **Net costs assuming different dropout rates – IT and Software Developers England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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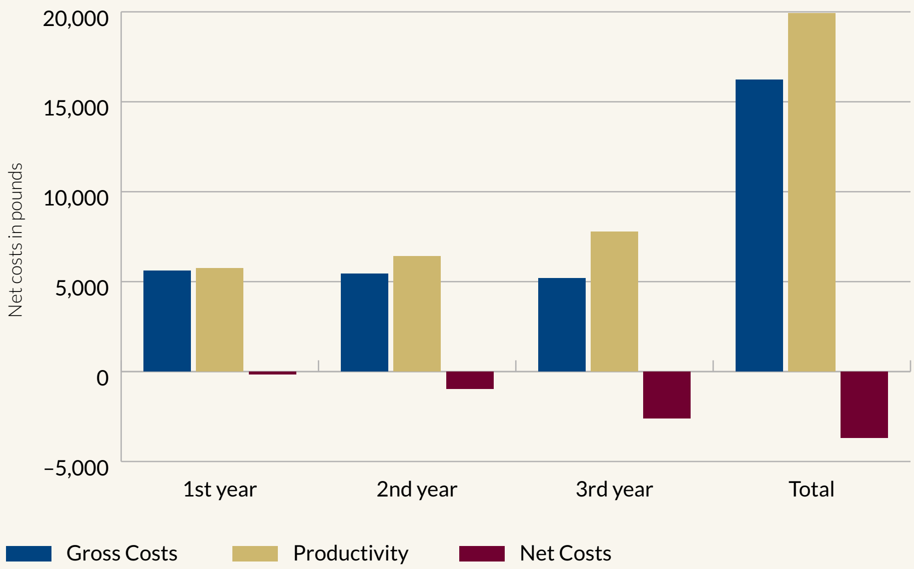
Retail Cashiers

TABLE A8 **Net training costs – Retail Cashiers England**

Wage	Model 1	Model 2	Model 3
low	–3,693	–701	–121
high	689	3,349	7,339

Source: own calculations

FIGURE A29 **Gross costs, productivity, and net training costs by year of training – Retail Cashiers England**



Source: own calculations, based on model 1 (low wage scenario)

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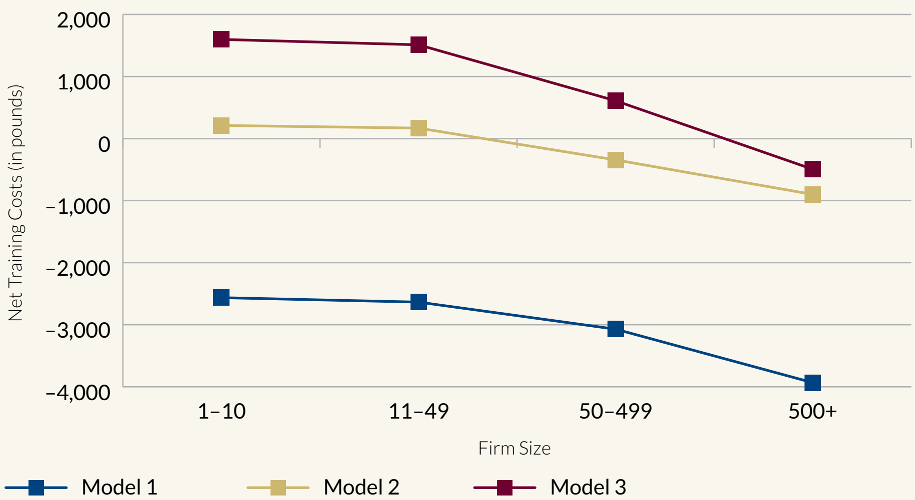
FIGURE A30 **Net costs by firm size – Retail Cashiers England**



Source: own calculations, based on model 1 (low wage scenario)

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FIGURE A31 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Retail Cashiers England**

Source: own calculations

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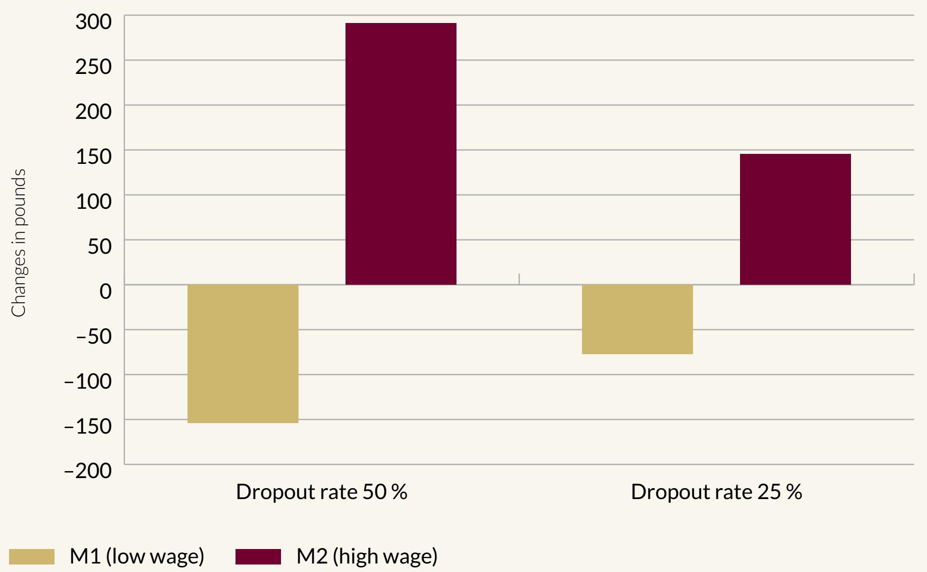
FIGURE A32 **Net costs assuming different dropout rates – Retail Cashiers England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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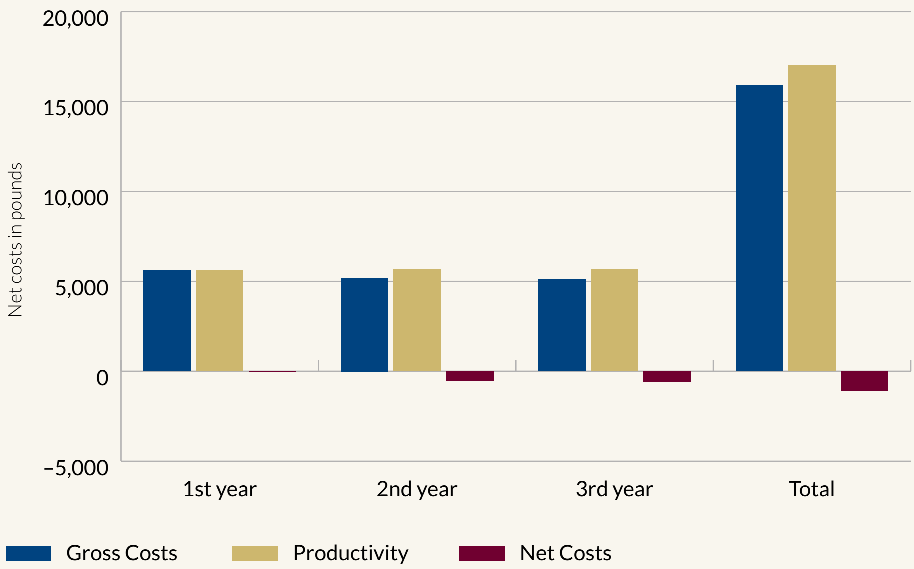
Waiters and waitresses

TABLE A9 **Net training costs – Waiters and Waitresses England**

Wage	Model 1	Model 2	Model 3
low	–1,088	1,792	3,853
high	3,050	5,742	11,007

Source: own calculations

FIGURE A33 **Gross costs, productivity, and net training costs by year of training – Waiters and Waitresses England**



Source: own calculations, based on model 1 (low wage scenario)

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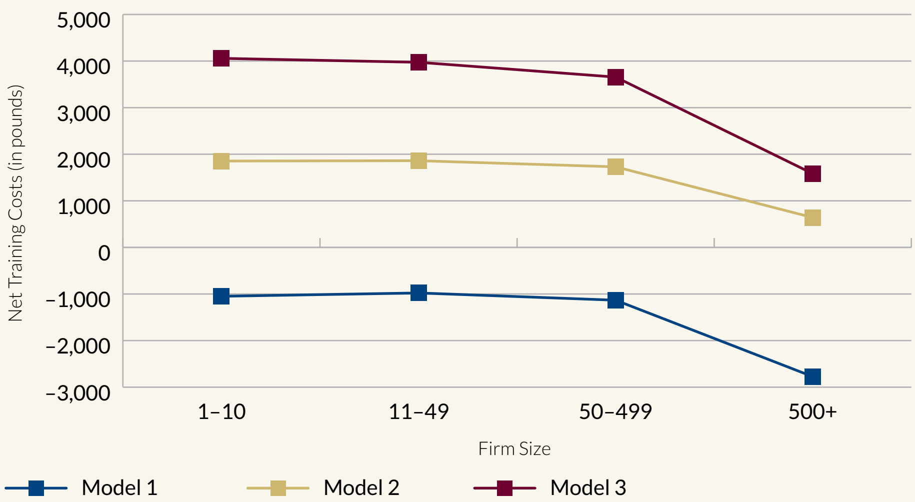
FIGURE A34 **Net costs by firm size – Waiters and Waitresses England**



Source: own calculations, based on model 1 (low wage scenario)

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FIGURE A35 **Break-even analysis of apprentice wage relative to unskilled and skilled wages – Waiters and Waitresses England**

Source: own calculations

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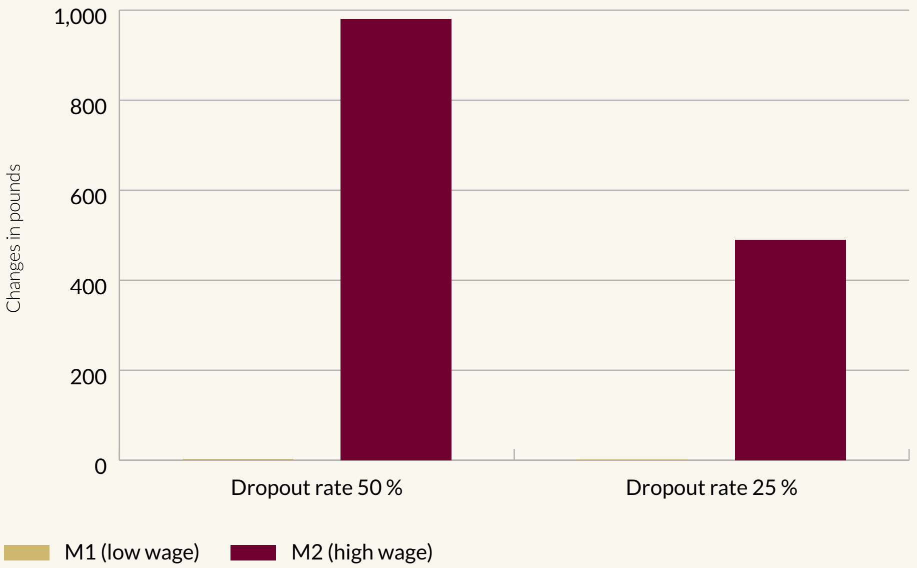
FIGURE A36 **Net costs assuming different dropout rates – Waiters and Waitresses England**



Source: own calculations, based on model 1 and 2 (low and high wage scenario).

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About the authors

Prof. Dr. Stefan C. Wolter is a renowned expert in economics of education with a particular focus on vocational education and training. He is the executive director of the Swiss Coordination Centre for Research in Education, holds a professorship at the University of Bern, acts as permanent visiting professor at the University of Basel and serves in numerous expert boards on education. Among others, he is Chair of the Expert Group on Vocational Education and Training and Adult Education of the OECD, member of the Education Policy Committee as well as member of the board of the Centre for Educational Research and Innovation (CERI) of the OECD in Paris. He has published numerous books, more than 50 peer-reviewed scientific publications, in journals such as the American Economic Review, the Journal of Public Economics or the Industrial and Labor Relations Review. Most relevant for this project are his several large-scale surveys for the measurement of costs and benefits in dual vocational education in Switzerland, and his comparative studies with Austria and Germany, as well as a recent simulation study for Spain.

Eva Joho studies economics at the University of Bern, where she works as a research assistant at the Centre for Research in Economics of Education. In July 2018, she will complete her Master's degree in Applied Economic Analysis with Specialization in Regional Economic Development. Eva Joho's main areas of research include economics, regional economics and personnel economics.

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Kamal Motalib
Philanthropy Manager
J.P. Morgan Global Philanthropy
kamal.h.motalib@jpmchase.com

Hanka Boldemann
Philanthropy Manager
J.P. Morgan Global Philanthropy
hanka.boldemann@jpmorgan.com

https://www.jpmorgan.com/country/DE/EN/corporate-responsibility

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If you would like to learn more about our activities or need additional copies of this study, please contact:

Clemens Wieland
Senior Project Manager
Learning for Life Program
Phone +49 5241 81-81352
clemens.wieland@bertelsmann-stiftung.de

Naemi Härle
Project Manager
Learning for Life Program
Phone +49 5241 81-81391
naemi.haerle@bertelsmann-stiftung.de

www.bertelsmann-stiftung.de/en

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Gerard Domínguez-Reig
Senior Researcher
Phone +44 20 7340 1160
gerard.dominguezreig@epi.org.uk

www.epi.org.uk

Workshop participants

- Allied Healthcare
- ANS Group
- Barrat Developments
- Byron
- Caretech UK
- Carillion Plc
- Citi group
- Compass Group
- Confederation of British Industry
- Construction Industry Training Board (CITB)
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Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
Germany
Phone +49 5241 81-0
www.bertelsmann-stiftung.de

Responsible for content
Clemens Wieland
Naemi Härle

Cover photo
Valeska Achenbach

Photos
Hang Ho: JP Morgan
David Laws: Education Policy Institute
Clemens Wieland: Kai Uwe Oesterhelweg
Professor Stefan C. Wolter: privat
Eva Joho:privat

Graphic design
Nicole Meyerholz

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Address | Contact

Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh | Germany
Phone +49 5241 81-0

Clemens Wieland
Senior Project Manager
Program Learning for Life
Phone +49 5241 81-81352
clemens.wieland@bertelsmann-stiftung.de

Naemi Härle
Project Manager
Program Learning for Life
Phone +49 5241 81-81391
naemi.haerle@bertelsmann-stiftung.de

www.bertelsmann-stiftung.en

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